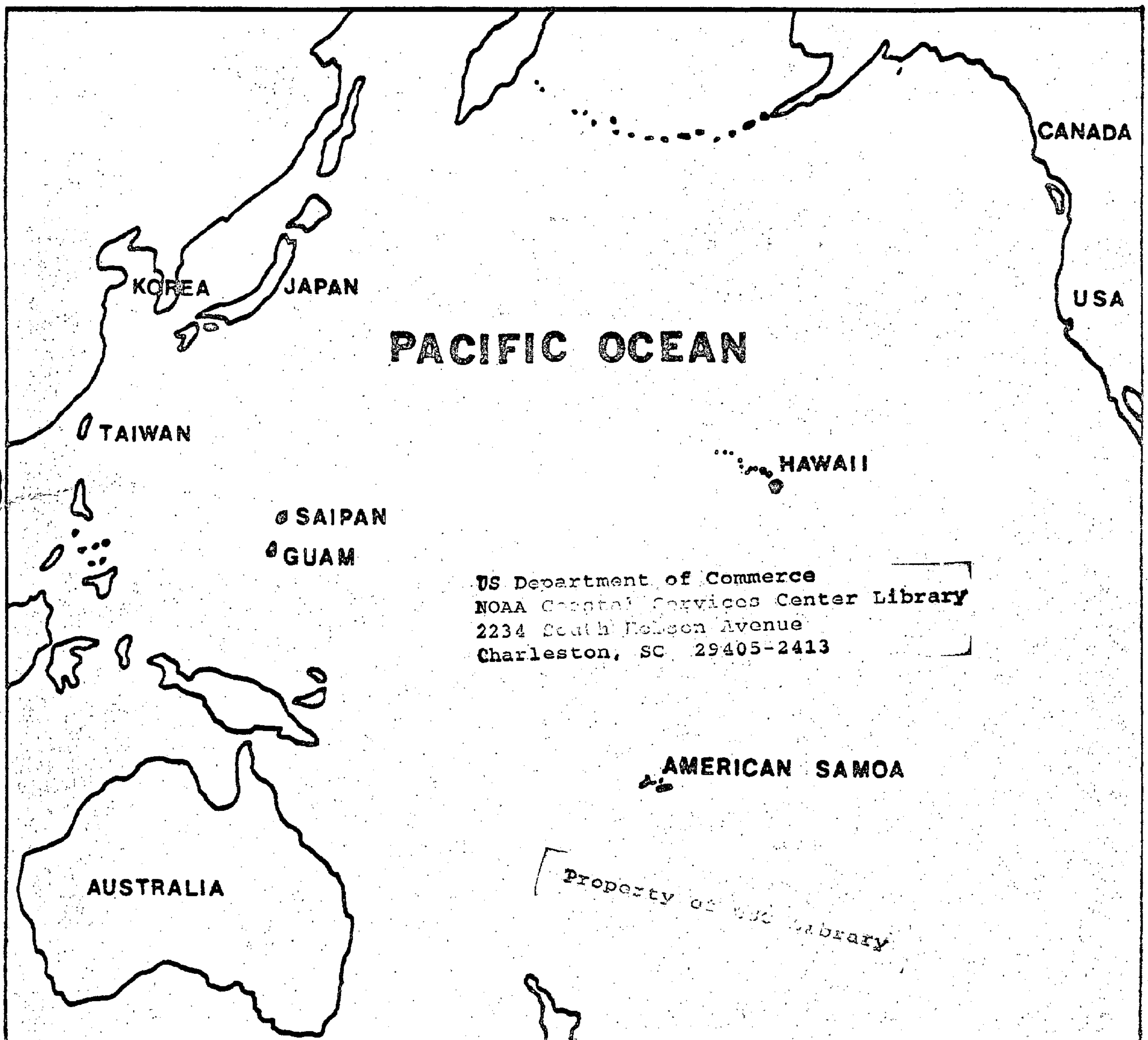
PACIFIC COAL TRADE: ECONOMIC OPPORTUNITIES FOR CNMI

ORIGINAL

COAL MOVEMENT IN THE PACIFIC BASIN STUDY



The Research Institute
Pacific Basin Development Council
Suite 620 ◦ 567 South King Street ◦ Honolulu, Hawaii 96813
Telephone (808) 523-9325 ◦ Telex 743-0668

PACIFIC COAL TRADE:
ECONOMIC OPPORTUNITIES FOR CNMI
COAL MOVEMENT IN THE PACIFIC BASIN STUDY

ORIGINAL

PREPARED FOR

THE COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

BY

MARCELINO K. ACTOUKA

PROJECT COORDINATOR

and

RAYMOND W. JENKINS

DR. WALTER MIKLIUS

JUNE 1983

AMERIKA SAMOA · GUAHAN · HAWAII · ISLAS DE LAS MARIANAS

The Research Institute

Pacific Basin Development Council

Suite 620 ○ 567 South King Street ○ Honolulu, Hawaii 96813

Telephone (808) 523-9325 ○ Telex 743-0668

EXECUTIVE SUMMARY

ACKNOWLEDGEMENTS

The Research Institute of the Pacific Basin Development Council is indebted to many individuals, government agencies, institutes and the private sector for assisting and encouraging this study to go forward. Of special recognition are Mr. Raymond Jenkins whose extensive knowledge of coal industry contributed a lot to the sections on the coal transshipment center and coal utilization; Dr Walter Miklius, a transportations economist, who developed the economic model for cost-benefit of coal transshipment; and the U. S. Army Corps of Engineers who share their expertise and experiences in the cost and design of ports and harbors in the Commonwealth of the Northern Mariana Islands. This study could not have been realized without the financial and logistical support of the Coastal Resources Management Office of the Planning and Budget Office of CNMI Government.

The editing and typing could not have been done without the dedication of Melody M. Actouka, Christol Allen and Joanne Howard. The guidance and support of Jerry B. Norris and Carolyn K. Imamura were instrumental in the formulation and the completion of this report.

Special recognition goes to the Open Grants of the East-West Center for giving me the time and supporting my leave to work with the Research Institute of the Pacific Basin Development Council.

The authors are responsible for the accuracy and the usefulness of this document.

Marcelino K. Actouka
Project Coordinator

CONTRIBUTORS

Marcelino K. Actouka	Project Coordinator, Research Institute of the Pacific Basin Development Council. B.S., Electrical Engineering; Masters in Urban and Regional Planning; and Ph.D. Candidate at the University of Hawaii on an East-West Center Grant. Former Energy Planner for the U. S. Trust Territory of the Pacific Islands.
Raymond W. Jenkins	Mining Consultant. B.S., Mining and Metallurgy, University of North Dakota. Currently consultant to the State of Hawaii Department of Planning and Economic Development (Manganese Nodule Mining and Processing) and Dillingham Corporation. While with Ralph M. Parsons, provided engineering and construction advice in development of phosphate, sulphur and coal ventures in the U. S. and various foreign countries.
Dr. Walter Miklius	Ph.D., Economics, University of California at Los Angeles. Professor of Economics and Agricultural Economics, Department of Economics, University of Hawaii. Recently completed a special assignment with the U. S. Department of Transportation in Washington, D. C.
Planning Branch, U. S. Army Corps of Engineers, Pacific Ocean Division	Port and Harbor Cost Estimates and Preliminary Design. Conduct of reconnaissance and design work for CNMI ports and harbors.

ABBREVIATIONS

Btu	: British thermal unit
C.I.F.	: Cost + insurance + freight
CNMI	: Commonwealth of the Northern Mariana Islands
CTC	: Coal Transshipment Center
DOE	: U. S. Department of Energy
DOI	: U. S. Department of Interior
DWT	: Dead Weight Ton
EPA	: U. S. Environmental Protection Agency
f.o.b.	: Free on board
GWH	: Gigawatt = 1,000,000 watts of electricity
HECO	: Hawaiian Electric Company
JPN	: Japan
k	: kilo = 1,000
m	: meter
MBtu	: Million Btu
Mt	: metric ton (2,205 lbs)
Mt/y	: metric ton per year
Mw	: megawatt = 1,000 kilowatts electricity
nm	: nautical miles
NSW	: New South Wales, Australia
PBDC	: Pacific Basin Development Council
QSLD	: Queensland
RFO	: Residual fuel oil
st	: short ton (2,000 lbs)
t/h	: ton per hour
TIN	: Tinian
TTPI	: Trust Territory of the Pacific Islands

TABLE OF CONTENTS

1

Summary of Findings

SUMMARY OF FINDINGS

INTRODUCTION

The Northern Marianas are a chain of 16 islands extending for some 480 km from north to south. The main island, Saipan, is located toward the south of the group, at 15° 12 min. N. lat. and 145° 43 min. E. long.

Their total land surface is approximately 471 sq km, with the three principal islands, Saipan, Tinian and Rota, accounting for two-thirds of the land area of the group. Only three other islands are inhabited. The population as of the 1980 census was 16,780, and is projected to reach 23,320 by 1990.

As is the case in other Pacific Islands, the government is the largest single employer. In 1977, various governments accounted for almost half of the total employment and paid 60% of all wages. The distribution of remaining employment by industry was as follows:

	Number of Workers
General Merchandise	773
Hotels and Other Catering	733
Construction	714
Transportation and Stevedoring	323

However, by 1982, the private sector expanded and employed 6,299 of the 8,681 wage earners. It is not too surprising that the Commonwealth's government would like to see a more diversified economic base and is making efforts to develop manufacturing industries. These efforts, however, are being hampered by lack of skilled labor and indigenous sources of energy. The parallel efforts are being made to develop maritime-related industries which would benefit for location of the islands. It has been proposed that as part of this effort, a coal transshipment center (CTC) (Figure 1.1) be developed on one of the principal islands.

The basic idea of the proposed CTC is rather simple. Coal would be transported to CTC in large bulk carriers (150,000 DWT) and reloaded to

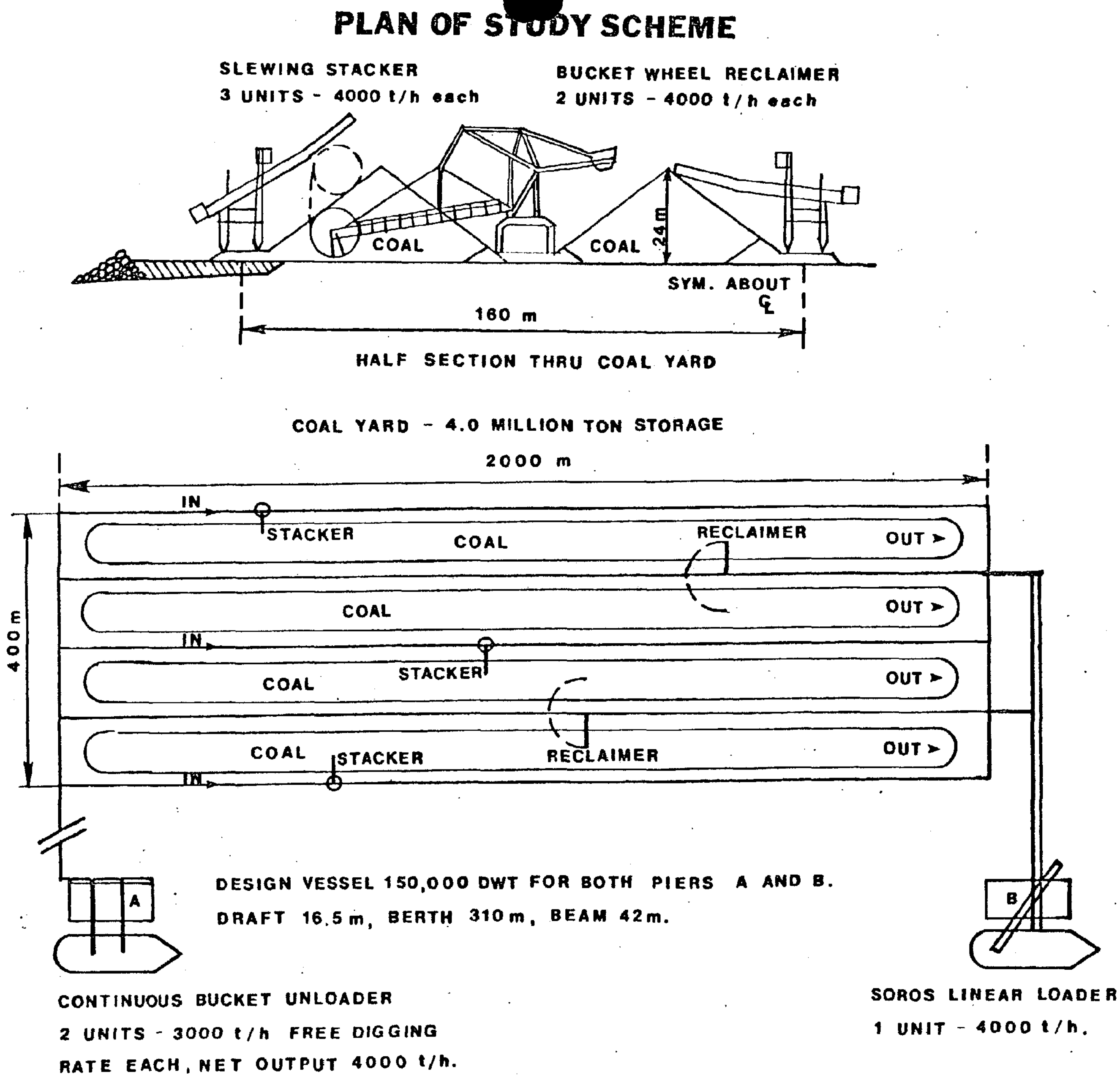


Figure 1.1 Coal Transshipment Center: Equipment, Rating and Dimensions

smaller vessels for delivery to receivers not capable of handling larger shiploads. The savings due to ability of utilizing large ships would more than offset unloading and loading of coal. The CTC would also be used for holding of a large enough stockpile for active and emergency use. It would include blending capabilities important to provide a broader supply base for thermal coal. The storage capacity would also provide opportunities to make strategic spot purchases.

The purpose of this study is to assess if the proposed CTC is likely to be feasible. Or more specifically, if the full scale feasibility study of the proposed CTC is warranted. To provide a background for this preliminary assessment, The Technical Report takes a look at the various aspects of the current and the projected pattern of international trade in coal in the Pacific area. The Executive Summary discusses the findings and the recommendations of this study.

The Appendix provides a list of terms that are used in this study.

FINDINGS

The findings of this study by the Consultants and concurred in by the Project Coordinator are as follows:

The geographic location of the CNMI in relation to the principal coal shipping routes to Japan from Australia, South Africa and South America makes the CNMI an economically logical site for a coal center (Figure 1.2).

A coal center complex includes facilities for the transshipment of coal from the 150,000 DWT long haul colliers to 60,000 DWT or smaller colliers for delivery to the consumer's ports. Stockpiling area for four million tonnes with provision for blending would be included in the complex. The coal handling equipment for unloading, stockpiling and blending, reclaiming and shiploading operating rates and environmental control facilities would be comparable to the most modern Australian terminals (Table 1.1).

An analysis of potential users for this facility reveals that the Japanese electric utility industry has an adequate demand base not met

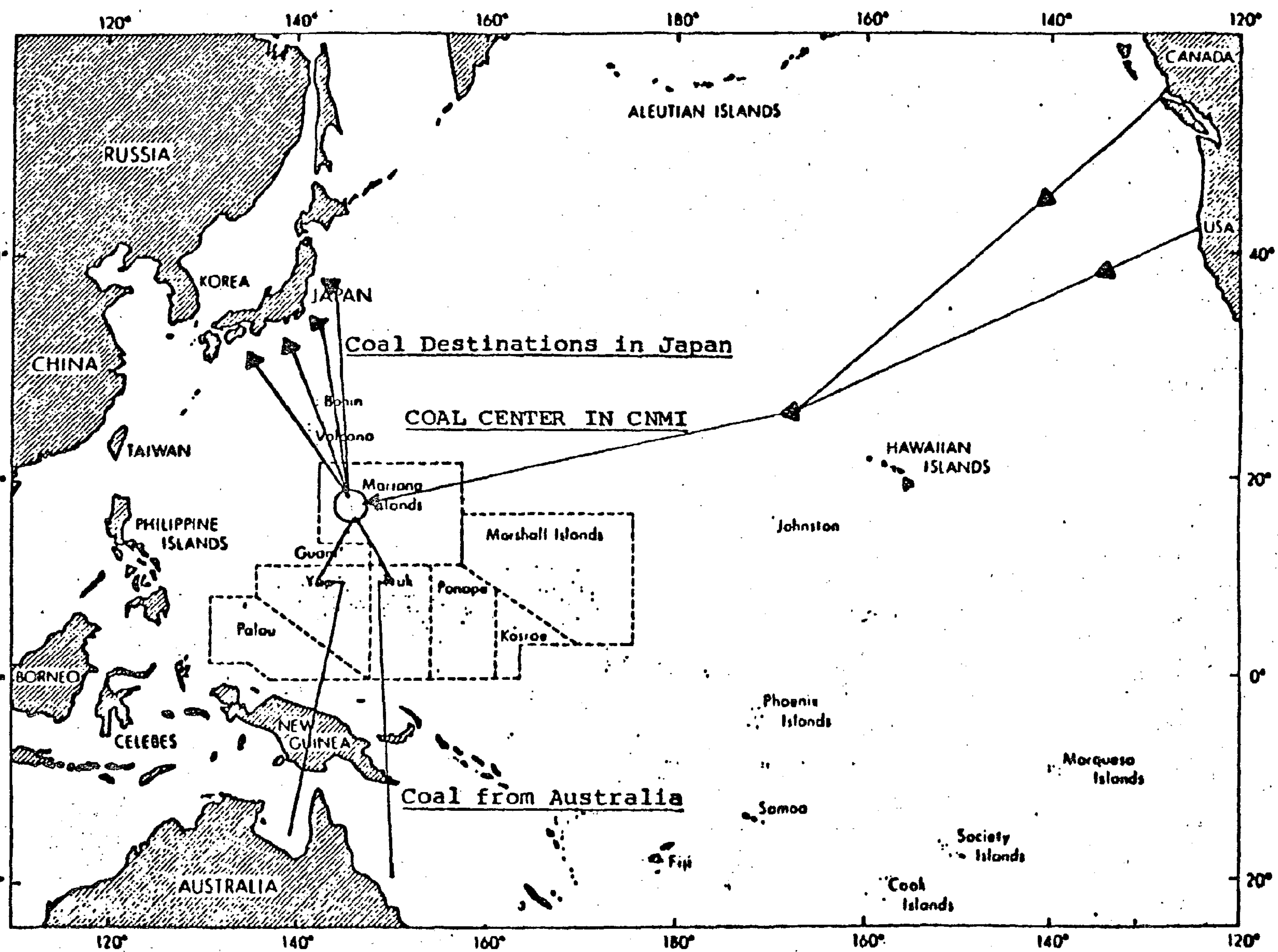


Figure 1.2 Coal Transshipment between Australia and Japan

Table 1.1 Major Port Loading Facilities

Country	Port	1983/84		1987/90	
		Maximum ship size 10^3 dwt	Throughput capacity mtpa	Maximum ship size 10^3 dwt	Throughput capacity mtpa
Australia	Abbott Point	150	4	150	10
	Hay Point	150	35	170	50
	Gladstone	120	21	120	39
	Newcastle	120	25	170	40
	Port Kembla	150*	14	170	30
Canada	Roberts Bank	150	24	150	24
	Prince Rupert	-	150	10	
South Africa	Richards Bay	170	35	170	65
United States	East Coast	120*	85	150*	110
	Gulf	60	30	150*	40
	West Coast	60	5	150*	20
South America	Columbia	-	-	120-150	15

*Partly laden   Maximum ship sizes and port capacities indicative only

Source: Shell Coal International

by present provisions for coal delivery to utilize the total services of a complex. The contemplated use rate is twelve million tonnes per year (Table 1.2) or 20% of the Japanese 1990 utility coal demand.

The economic viability of the facility is based on the value of the services rendered to the user. The potential savings on ocean freight rates by combining 150,000 DWT colliers for three quarters of the distance with smaller colliers to deliver coal to the utility consumers will largely pay for the use of the facility (Table 1.3). This is of course dependent on expeditious coal handling. The stockpiling and blending capabilities are an added inducement of major consequence to a potential user.

Economic viability of the concept based on "order of magnitude" capital cost of $50 million indicates that with projected fees similar to other terminal fees of $2.50/tonne and a 12 Mt annual turnover, the revenues would be $30 million. Land rent of $0.80/t or $10 million would revert to the Government of CNMI. Six million dollars would apply to amortization. Operating costs would be on the order of $14 million a year. One hundred persons would be directly employed, with indirect employment affecting 300 persons. Opportunities for supporting service companies would be generated (Table 1.4).

A tentative location lying south of the DOE reserve area on the Island of Tinian has been used in these projections (Figure 1.2). The land requirement contiguous to a potential harbor site is on the order of 500 acres. A potential site for an offloading pier and a loading pier with depths of 55 ft. (16.7m) appears to be available.

Additional benefits of a coal center would include availability of relatively cheap coal for transshipment to Saipan, Guam and other nearby islands. A coal-fired power plant to provide power for the center could include the capacity to service the military facility and a cable to Saipan.

Alternative transshipment concepts were studied. The conclusion was that these concepts were not viable at a fee structure attractive to potential users. The quality of essential services required by any potential user requires an investment level that precludes smaller facilities.

Table 1.2 Actual and Predicted Use of Thermal Coal by Japanese Industries, 1981, 1984 and 1990*/

Industry	1981	1985	1990
		(10^6 tons)	
Electric Utilities	12.3	20.0	33.0
Cement	9.1	12.5	14.0
Paper, etc.	3.5	6.5	9.0
Total	24.9	39.0	56.0

*/Includes domestic mined coal.

Source: Coal Industry, June 1982

Table 1.3 Estimation of Transshipment Cost Savings

	Direct Shipment	Transshipment		
	NSW-JPN	NSW-CTC		CTC-JPN
Deadweight tons of ships	60,000	100,000	150,000	60,000
Tons of coal shipped	58,200	97,000	145,000	58,200
Days in ports	2.3	2.6	5.1	0.8
Daily cost in port ($)	18,275	22,582	26,713	18,275
Total Cost in port ($)	42,033	58,713	104,181	14,620
Days at sea*	23.7	17.2	17.2	6.5
Daily cost at sea ($)	27,284	33,379	39,173	27,284
Total Cost at sea ($)	646,631	574,119	673,776	177,346
Total shipping cost ($)	688,664	632,832	777,957	191,966
Average cost per ton ($)	11.83	6.52	5.35	3.30
		NSW-CTC-JPN		
		9.82	8.65	
Transshipment cost savings		2.01	3.18	

* Days at sea are calculated on the round trip basis; Vessel's speed is 15 knots; Distances are as follows:

NSW (Newcastle, N.S.W.) - JPN (Japan, Yokohama): 4,268 nautical miles;

NSW - CTC (Coal transshipment center, Tinian): 3,096 nautical miles;

CTC - JPN: 1,172 nautical miles.

Table 1.4 Estimated Capital Costs of the CTC

Item	Million US$
Site work	3.0
Marine Construction	8.0
Foundations	3.0
Three Stackers	6.0
Two Reclaimers	10.0
One Shiploader	10.0
Material Handling	10.0
Total	50.0

LAND CURRENTLY LEASED BY THE MILITARY FOR JOINT SERVICE TRAINING

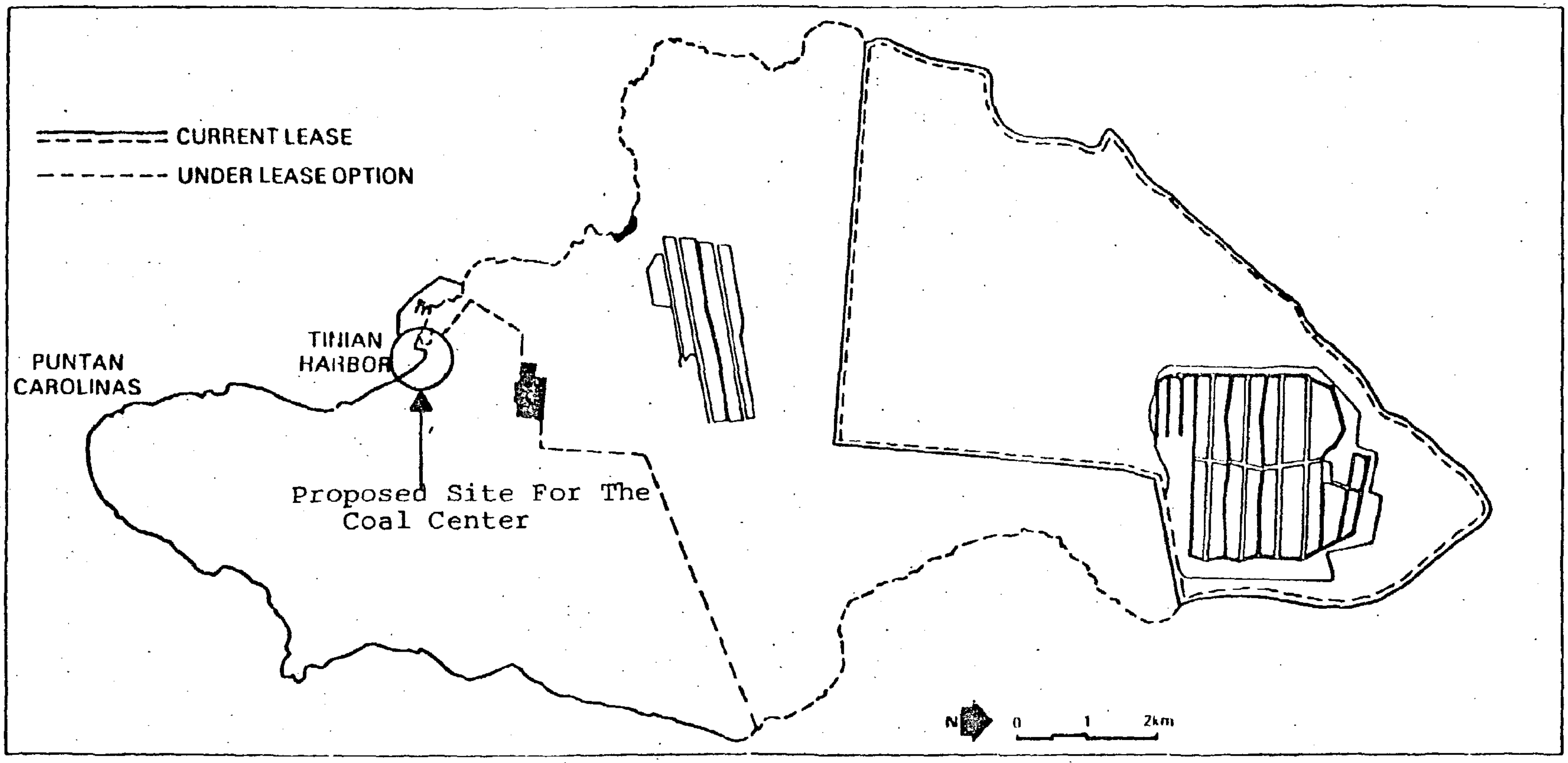


Figure 1.2 Proposed Site for the Coal Center and Military Land Lease

The use of coal to fuel future extensions of the Saipan electric generation facility appears to be economically desirable. Expending installation of coal-fired units may be justified. Use of existing internal combustion units for future standby would enhance the quality of service available to the community. The potential of cable service from a large facility located at the coal center would be preferable.

SITE VERIFICATION

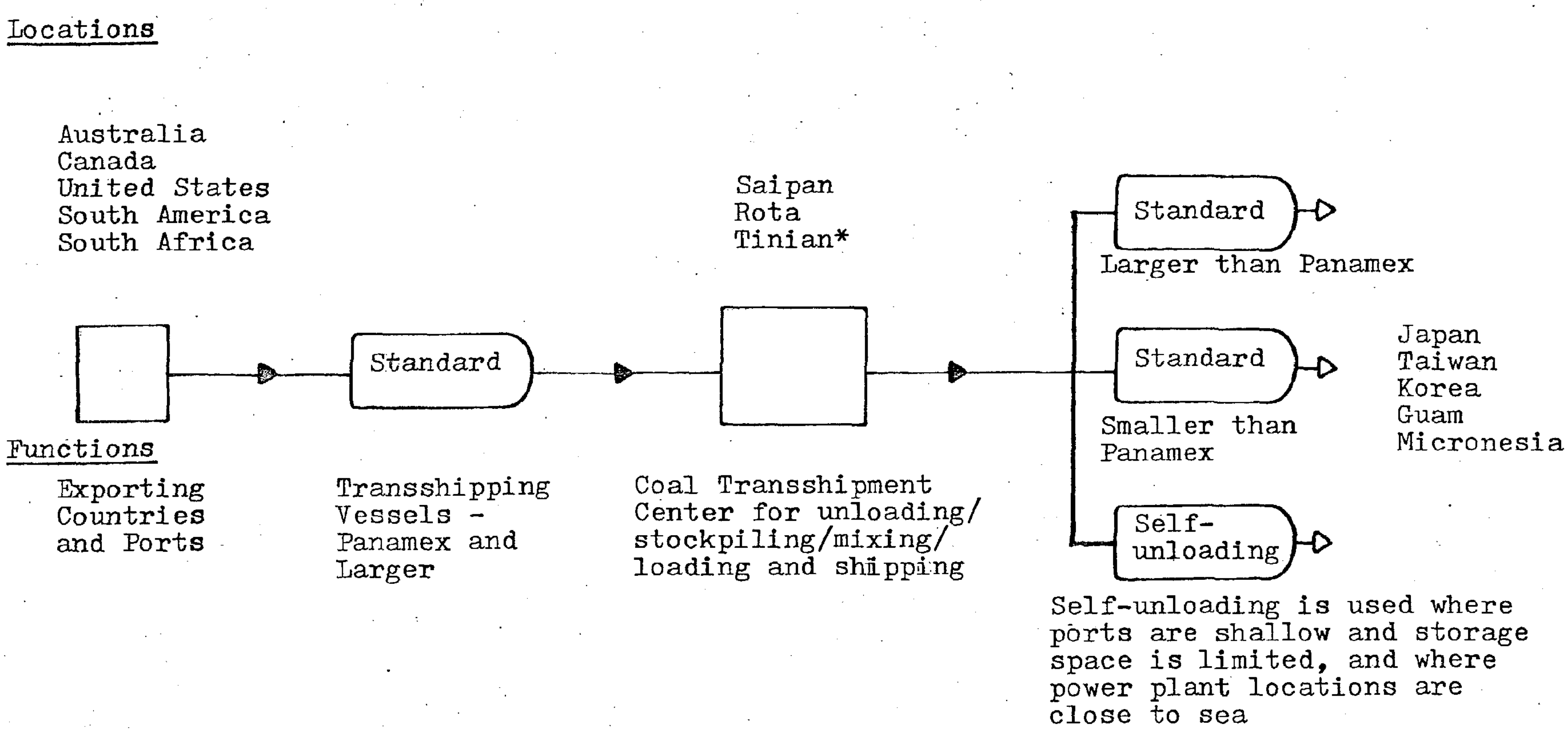
Discussions with officials of the Northern Mariana Islands during an October 1982 site visit resulted in the following findings. In general, they support the concept of a coal transshipment center in CNMI.

1. Through discussions/interviews with the leaders of the executive, legislative and the private sector, it was found that there is a genuine support for both the assessment of the feasibility of coal transshipment through the CNMI and, if proven economic and technically feasible, for eventual construction of the infrastructure to support the transshipping activities. It was further stated by the leaders of the Saipan legislature that support for both could be forthcoming in the forms of resolutions or even fund allocations.

2. It was disclosed that as early as six years ago, the Government of CNMI seriously considered the use of steam coal for power generation and invited two Australian firms to assess the possibility of initiating a steam power plant.

3. The idea of transshipment is not new. Both the private sector and the government have been approached by Japan, a consumer of steam coal, and South Africa, a supplier of coal, for a coal transshipping center in CNMI. The two are not directly related, but it shows that both the supplier and the consumers believe there is a good possibility for a transshipping center in the Pacific (Figure 1.3).

4. Most land areas potentially suitable for coal storage have already been designated for specific purposes (e.g., small industry, commercial and farming activities, military retention and conservation).



*Note: In this report, calculations are based on Tinian Harbor as the best potential site.

Figure 1.3 Coal Transshipment Functions, Components and Locations

However, officials of the Marianas Public Land Corporations and others have indicated that if coal transshipment were to prove economical (i.e., it could provide jobs and revenues), there is a good possibility that priorities could be adjusted. With regard to military retention areas, there is a provision in the Northern Mariana Islands Land Lease that will allow both joint use of land and the construction and use of the shore areas for ocean-related activities. This would allow the construction of port facilities and harbors in the retention areas, especially on Saipan by Charlie Dock and in the Tinian Harbor area.

5. Frequent power outages and the ever increasing cost of imported oil for power generation (CNMI is budgeting $7 million of its $33 million 1983 FY Budget for power plant fuel) have contributed to the government's interest in assessing other sources of fuel. Although efforts are being expended in the indigenous energy resources, for the mid-term period, coal is becoming a more acceptable option for the officials of CNMI.

6. The officials on Rota are concerned about the lack of private sector jobs which has contributed to the continued out-migration of the young and educated population to Guam and Saipan. A coal transshipping activity was seen as both a potential economic boost to the depressed area and a means of attracting people to stay on the island. Secondarily, officials hope that jobs and commercial activities will to help defer the already stagnant government sector and the non-competitive agriculture ventures.

The two existing Rota ports, East and West Harbors, are not in any condition to handle even small vessels. There are no piers, storage warehouses, cranes or forklifts. The East is too exposed to the open ocean. The West has shallow and very narrow channels, and the currents at high tide are hazardous to moving as well as anchored vessels. The Corps of Engineers has let bids to improve West Harbor facilities; however, from the design criteria and the physical constraints, the new improvements would not allow ships of 50,000 DWT to offload coal. In addition, neither dock has large flat surplus areas adjacent to it.

7. Disregarding the Military Lease on Tinian, that island offers the most ideal channel, harbor and land area (Table 1.5). Most of the

Table 1.5 Cost Estimates of Dredging of Harbors on Saipan, Tinian and Rota

Location	Channel (feet) Depth	Channel (feet) Width	Channel (feet) Length	Turning Basin (feet) Radius	Turning Basin (feet) Depth	Estimated Cost (in million dollars)
Saipan Charlie Dock	40	500	9,400	800	40	20
	50	530	9,500	1,000	50	35
	60	600	9,500	1,300	60	71
Tinian San Jose	50	530	not given	not given (not enough area)	50	25
Rota West Harbor	50	530	not given	not given (not enough area)	50	4

*Note: The given depths correspond to the following design vessels:

40 feet 700 feet ore carrier or 50,000 DWT
50 feet 900 feet ore carrier or 125,000 DWT
60 feet 1,200 feet ore carrier or 160,000 DWT

55 feet Draft and 150,000 DWT is used in the costs estimates for Tinian Coal Center.

Source: Corps of Engineers Preliminary Cost Estimate, February 13, 1983.

island is flat at very low elevation and lacks major infrastructures. The roads and the old air fields used during World War II are still in excellent condition.

The small town is close to the dock but would not be in the way of any major expansion of warehousing, machine shops, stockpiling and movement of coal (Table 1.6).

Currently, the major commercial activities are farming, in which Pacific Energy of Japan is growing sorghum for alcohol, and the cattle/dairy farm. Both would be compatible with a coal storage center in that the center would basically use the shore area and not the agriculture and grazing land needed for the other two commercial activities.

It was also pointed out that if transshipping is proven to be more economical, land use priorities can be readjusted. The island leaders are also interested in encouraging people to stay on the island by providing more meaningful and challenging jobs which the center could create.

The location of a stockpiling center on Tinian could also be an advantage to the Island of Guam, which is currently considering conversion of power generation to steam coal from the low grade oil. Recent discussions with energy officials of Guam have verified this statement.

Depending on the Defense plans for the utilization of half of Tinian, a coal steam power plant could be both an asset to the military and a reliable source of power for the dairy plant, alcohol processing plant and the people of Tinian (Figure 1.4). And, with the steam coal stockpile on island, a more secure source of electricity could be attained.

8. It was also verified that at least two oil companies are considering the potential for oil transfer/storage activities in CNMI. The possibility of such plans, in concert with the coal transshipping center, could provide a unified and reliable source of jobs, revenues and energy for the CNMI. A number of possible sites are being considered: two on Saipan, two on Rota and one on Tinian.

9. In the CNMI, there is no labor union and at this point officials do not envision one emerging. Existing labor laws have provisions for the minimum wage for laborers. These two factors are advantageous to

Table 1.6 Site Selection Criteria and Required Characteristics for Coal Transshipment Center

Channel/harbor Depth (55 feet minimum)		Stockpiling/ Blending Area (500-700 acres)	Roads/Utilities	
:isting	Dredging Cost[1]	Available	Existing	Cost of Expansion
No	High	No[2]	Yes	Low
No	High	Yes	No	High
No	High	No	Yes	Low
No	High	No	Yes	Low
No	Low	Yes	Yes	Low

ıy Corps of Engineers Cost of Dredging of Harbors on Saipan, Tinian and Rota.

on Saipan but not adjacent to the Charlie Dock for conveyors to transport stockpiles and back to ship for export.

.uded in the sites as it has been considered as a potential site for oil ıt, and the two activities are compatible and can share most of the 'his will result in reduced capital and operation/maintenance costs.

ı and t ıizer)

ər ıation

ːtric ver

ːs ınd

ıd ıts)

ıent .ng)

lary ːies

ıcts

coal transshipping activities, which would require reliable work for scheduled times and as low as possible handling fees for transferring storage and ship loading.

10. All three major power plants in Saipan, Tinian and Rota are within 100 yards of the water line. This could be advantageous for steam coal unloading and cooling of the power system if future plans call for coal steam generation.

11. The depth of water (less than 1,000 ft) and the distance between point Ushi on Tinian and Puntan Agigan on Saipan is about 2 miles, and most of it is in waters about 500 feet. There is a potential for a coal-fired 50 megawatt power plant located on Tinian, if a coal center is placed there, to power both islands with a D.C. marine cable linking them.

COAL TRADE IN THE PACIFIC REGION

The CTC is likely to be economically feasible if it serves the needs of international trade. This section therefore describes the current and the projected pattern of international trade in coal in the Pacific region.

Japan is the largest importer of coal not only in this region but in the world as well. In 1981, Japan's imports of coal accounted for about 40% of the world's coal trade and for almost 90% of the Pacific region's coal receipts. Other principal importers in the region are South Korea and Taiwan, while Australia, the United States, Canada and South Africa are the principal exporters of coal to the region. The volume and the pattern of trade in the Pacific region are summarized in Table 1.8.

Currently, the world coal trade is dominated by trade in coking and matallurgical coals, which in 1981 accounted for about 60% of the total world's seaborne trade in coal. However, it is generally expected that the future coal trade will increasingly consist of thermal coal used for generation of electricity as well as in some industrial processes (primarily in cement, pulp, and paper and chemical industries). In fact, according

Table 1.8 Coal Trade in the Pacific Region
Major Importing and Exporting Countries, 1980 and 1981

	Exporters							
	Australia		U.S.		Canada		S. Africa	
Importers	1980	1981	1980	1981	1980	1981	1980	1981
Japan	30.13	35.02	20.93	23.44	10.45	10.85	3.29	4.22
S. Korea	2.28	3.49	1.25	1.50	1.13	1.90	0.00	NA
Taiwan	1.93 a/	1.44 a/	0.75	2.74	—	--	1.63	0.71
All Asia	34.34	39.95	22.93	27.68	11.58	12.75	5.22	NA

a/ Year ended June 30.

Source: Compiled from data supplied by Coal Industry Quarterly, June 1982.

to some forecasts, the volume of world's oceanborne thermal coal trade is expected to triple or quadruple by 1990 from the volume reached in 1990. According to two available forecasts, shown in Table 1.9, the imports of thermal coal by the Pacific Rim countries are expected to increase at an even faster rate.

Japan's imports of thermal coal increased dramatically in recent years, and this trend is expected to continue into the future as existing plants in several energy-intensive industries are converted and new plants that are designed to use coal come on steam. For example, the electric power industry at present has a total of 40 coal-fired power units with a total output of 5,760 MW. In the next ten years, the industry is planning to build 40 new coal-fired units or two converted oil-fired units into coal-fired units with a total capacity of 24,000 MW (Shibukawa, 1981).

The set of latest long run estimates of Japan's total volume of thermal coal imports is reproduced in Table 1.10. Given the high degree of uncertainty, it is not surprising that they vary widely. The official government estimate is 54 million tons by 1990. However, opinions have been expressed that this estimate is too conservative and that imports are likely to exceed 60 million tons (Uehara, 1981, and Shibukawa, 1981). On the opposite side are Toichi and Furuto (1983), economists with the Institute of Energy Economics, who argue that the government's forecast is an overestimate since it was based on a 5% per year economic growth. However, Japan's economic growth in 1980 and in 1981 was under 3% per year. They further argue that the demand for energy will be lower even if the economy again reaches 5% growth rate because Japan's energy-intensive industries, due to high energy prices, have lost much of their international competitiveness. Thus, there already has been a shift in the industry structure from energy-intensive industries such as steel, cement, petrochemicals and aluminum refining, to manufacturing, assembly and service industries. Slow growth or stagnation of these industries will reduce the future energy demand, which in turn will reduce the volume of thermal coal imports. In short, there is considerable uncertainty regarding the volume of Japan's thermal coal imports. It should be

Table 1.9 Actual and Predicted Imports of Thermal Coal by Country, 1981, 1985 and 1990

Country	1981 (1)	1981 (2)	1985 (1)	1985 (2)	1990 (1)	1990 (2)
			(10^6 tons)			
Japan	9.4	N.A.	27.5	N.A.	62.7	N.A.
Korea	0.5	1.2	8.7	8.0	15.8	11.5
Taiwan	--	3.5	3.5	8.9	15.8	13.6
Hong Kong	--	--	4.7	2.8	8.2	5.9
Singapore	--	N.A.	--	N.A.	1.6	N.A.
Philippines	N.A.	--	N.A.	0.7	N.A.	2.9
Malaysia	N.A.	--	N.A.	0.6	N.A.	2.4

Sources: (1) Cited in Borg (1982); (2) Kimura (1983).

Table 1.10 Forecasts of Japanese Thermal Coal Imports, 1985 and 1990

Date of the Forecast	1985	1990
	(10^6 tons)	
4/81	28	51
5/81	20.1	49.6
10/81	--	45
4/82	--	54
3/83	24.5-25.5	29.5-33

Sources: Tinsley (1982), Coal Industry Quarterly, June 1982, and Toicho and Furuto (1983).

Table 1.9 Actual and Predicted Imports of Thermal Coal by Country, 1981, 1985 and 1990

Country	1981 (1)	1981 (2)	1985 (1)	1985 (2)	1990 (1)	1990 (2)
			(10^6 tons)			
Japan	9.4	N.A.	27.5	N.A.	62.7	N.A.
Korea	0.5	1.2	8.7	8.0	15.8	11.5
Taiwan	--	3.5	3.5	8.9	15.8	13.6
Hong Kong	--	--	4.7	2.8	8.2	5.9
Singapore	--	N.A.	--	N.A.	1.6	N.A.
Philippines	N.A.	--	N.A.	0.7	N.A.	2.9
Malaysia	N.A.	--	N.A.	0.6	N.A.	2.4

Sources: (1) Cited in Borg (1982); (2) Kimura (1983).

Table 1.10 Forecasts of Japanese Thermal Coal Imports, 1985 and 1990

Date of the Forecast	1985	1990
	(10^6 tons)	
4/81	28	51
5/81	20.1	49.6
10/81	--	45
4/82	--	54
3/83	24.5-25.5	29.5-33

Sources: Tinsley (1982), Coal Industry Quarterly, June 1982, and Toicho and Furuto (1983).

noted, however, that even the lowest forecast represents a very sizable increase over the current level of thermal coal imports.

The distribution of Japan's imports of thermal coal by source is shown in Table 1.11. No drastic changes in this distribution are expected in the future. Australia is expected to supply about half of Japan's imports.

This short overview suggests that the current and the projected patterns of coal trade in the Pacific region are generally favorable to potential feasibility of the CTC. First, Japanese coal imports are expected to increase substantially in the future, and Japan is likely to be a major user of the CTC. Construction of coal receiving facilities is either underway or funds for their construction are committed in Taiwan and Korea. Similarly, coal centers are being planned in Indonesia and the Philippines. These countries are planning to increase domestic mining of coal in the future, but initially would import coal for their own use and for transshipment ot Southeast Asia. None of these countries are likely to be users of the CTC located in the CNMI.

Second, Australia is expected to remain the major supplier of coal to Japan. As was pointed out above, the CNMI lies on the direct route from Australia to Japan.

Third, the major increase is expected to be in thermal rather than in coking coals. The existing port infrastructures in Japan were developed to serve the metallurgical coal trade. These facilities are well equipped and can handle shiploads of 100,000 tons or larger. These terminals, however, generally lack facilities for major transshipment of coals, which is what the growing traffic in thermal coal will demand because many coal-fired power stations and other industrial plants do not have sufficient berth depths for suitable unloading facilities to handle large direct shiploads.

While some improvements in handling facilities will be forthcoming, according to one available forecast, shown in Table 1.12, even by 1990 a substantial proportion of shipments destined for Pacific Rim countries, including Japan, will be to destinations unable to handle ship sizes in excess of 60,000 DWT. These receivers are the most likely users of the CTC.

Table 1.11 Japanese Thermal Coal Imports by Source, 1980 and 1981

Source	1980		1981	
	10^6 tons	%	10^6 tons	%
Australia	3.5	67.6	5.7	48.8
U.S.	.3	5.5	2.1	18.2
S. Africa	.2	4.6	1.3	10.8
PROC	.6	11.7	1.2	10.2
Canada	.3	6.3	1.1	9.8
USSR	.2	4.3	.3	2.2
Total	5.1	100.0	11.7	100.0

Source: Coal Industry Quarterly, June 1982.

Table 1.12

1990 Receiving Port Capacity
For Pacific Rim Steam Coal Imports
By Vessel Size Accommodated

(10^6 tons; % of Total Capacity)

Vessel Size	Japan		Taiwan		Korea		Total	
100,000+ DWT	23.8*	39%	18.4	69%	5.2	31%	47.4	45
60,000+ to 100,000 DWT	11.9	19%	-	-	4.6	27%	16.5	16
Panamax or smaller (to 60,000 DWT)	25.8	42%	8.1	31%	7.2	42%	41.1	39
	61.5	100%	26.5	100%	17.0	100%	105.0	100

*Includes 7.0 million tons capacity planned for Sakito Coal Center. Construction of this facility by 1990 is now considered uncertain.

Source: H. P. Drewry Shipping Consultants, Ltd. (1980)

In fact, the Japanese plant in Matsushima, located in the southwestern tip of Kyushu, could serve as a prototype of such a user (Figure 1.5). The plant has an output of 1,000 MW and requires 2,080 kt of thermal coal per year. The coal handling facilities include a berth with 14 m draft for 60,000 DWT bulk carriers. Unloading is done by four 700-t/h units to which has been assigned a 1,540 t/h rate. The plant has a 430-kt ground storage. It is the most modern coal-fired unit in Japan and probably represents the standard for new future coal-fired plants. In addition to Matsushima, there are eight other coal receiving facilities that are either in operation now or are expected to be in operation before 1990 and that are designed to serve electric power plants. Including Matsushima, the combined throughput of these facilities is estimated at 22.1 million tons per year (WESTPO, 1981). It seems reasonable to assume therefore that there should be sufficient demand for the CTC with a throughput of 10 million tons a year.

ENUMERATION OF COSTS

Capital and operating costs were needed in order to determine if the stream of benefits estimated in the preceding section exceeds the stream of costs, and if the cost savings are sufficient to offset an extra cost of unloading, loading, stockpiling and/or blending of coal at the CTC. It was indeed very fortunate that the cost information on the newly completed coal terminal at Port Kembla, NSW, was available (Soros, 1981). These data provided the basis for some "order of magnitude" estimates for the CTC.

The estimated construction costs of the CTC are shown in Table 1.4. They were obtained by scaling down Port Kembla costs and by eliminating costs of facilities not to be included in the CTC. The construction is assumed to take three years with the following distribution of capital expenditures:

First year, 25%
Second year, 35%
Third year, 40%

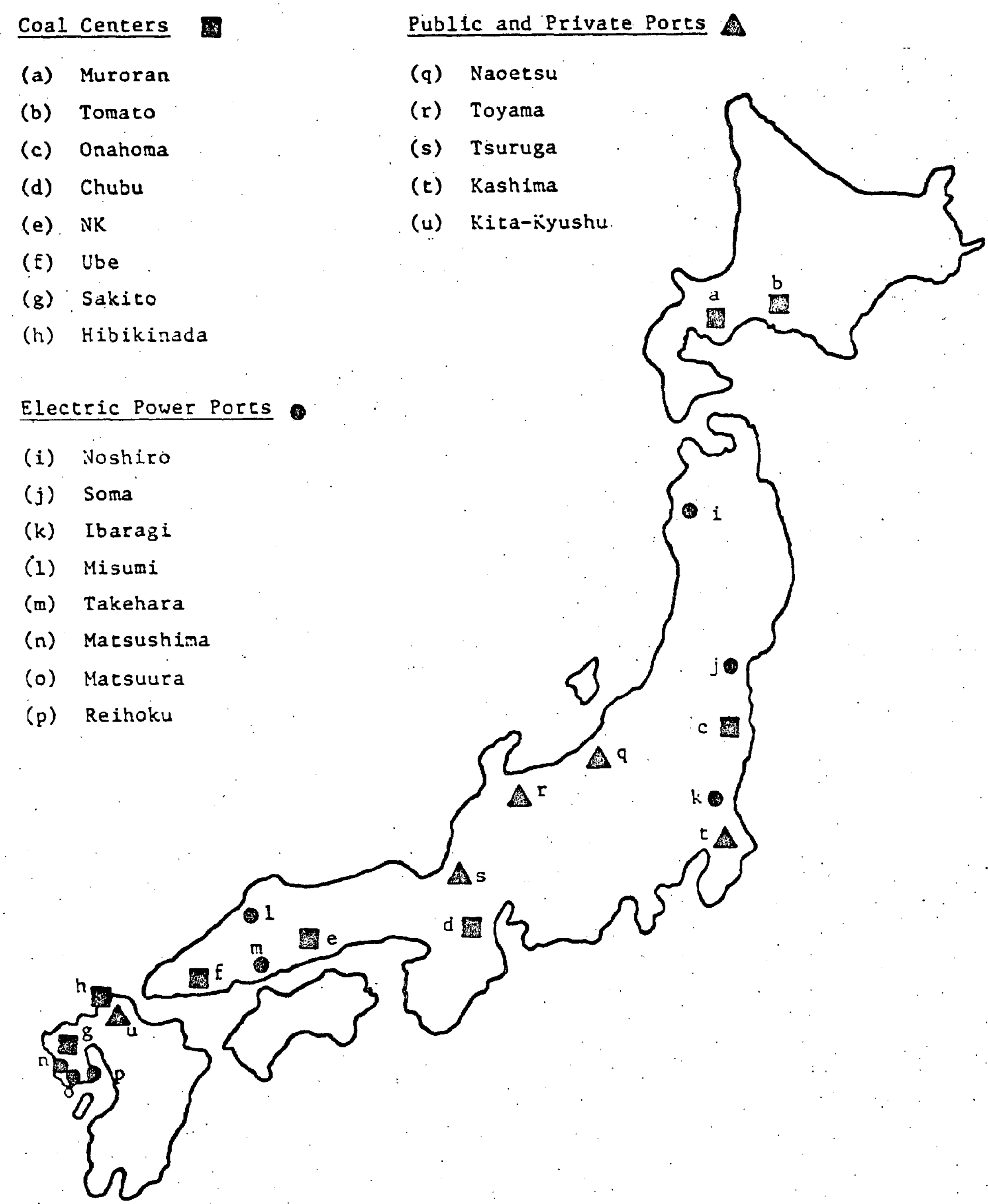


Figure 1.5 Japanese Coal Receiving Terminals, 1990

Source: Report of the Port and Marine Task Force (Soros, 1981)

The useful life is assumed to be 25 years without any salvage value.

An order of magnitude estimate of operating costs for the CTC is as follows:

Labor (all categories, 100 @ $40,000/yr)	M $ 4.0
Operating Expenses	4.0
General and Administrative Expenses	1.0
Total	9.0
CNMI Charges	5.0
Total	M $14.0

The CNMI charges are assumed to include ground rent and other charges/taxes paid to CNMI governments.

For transshipment of coal, the CTC is assumed to be $2.25. This charge appears to be within the range of port charges at several non-U.S. ports (Table 1.13).

PRELIMINARY ASSESSMENT OF FEASIBILITY

One should distinguish between two types of feasibility assessments: economic feasibility and financial feasibility. An economically feasible project is defined as one that generates "benefits" to whomever they accrue in excess of the economic value of the "costs" regardless of who incurs them. However, only the value of the increment in output arising from a given investment should be counted as benefit. Similarly, only real resource costs incurred in producing that increment of output should be counted as cost.

The present value rule which is logically superior to the others was used to determine both feasibilities. The project was considered economically or financially feasible if the present value of the associated stream of benefits or revenues exceeded the present value of costs.

The present value is defined by the formula

$$PV_o = \frac{S_1}{(1+i)} + \frac{S_2}{(1+i)^2} + \frac{S_3}{(1+i)^3} + \ldots + \frac{S_n}{(1=i)^n}$$

Table 1.13

COAL LOADING CHARGE VARIOUS COAL LOADING TERMINAL

	CANADA		AUSTRALIA			SOUTH AFRICA
			N S W		QUEENSLAND	
	NEPTUNE	ROBERTS BANK	NEWCASTLE	PORT KEMBLA	AUCKLAND POINT	RICHARDS BAY
(CHARGE)						
Stacking & Loading	2.50	2.40	4.20	3.52	1.75	2.60
Wharfage	-	-	0.40	0.44	-	-
Harbour Due	-	-	-	-	0.25	-
Total (Local Currency)	C$2.50	C$2.40	A$4.60	A$3.96	A$2.00	R2.60
(Exch.)	(0.80)	(0.80)	(0.85)	(0.85)	(0.85)	(0.90)
US$ per M/T	2.00	1.90	3.91	3.37	1.70	2.34
(CAPACITY)						
Loader Capacity (Mechanical)	3,000t/h x 2	4,000t/h x 2	2,500t/h x 3	3,500t/h x 2	8,000t/h x 2	3,500t/h x 2
Max. Size of Vessel to be accommodated	125,000 DWT	125,000 DWT	110,000 DWT	110,000 DWT	55,000 DWT	150,000 DWT
Stockpile Capacity	220,000 t	1,200,000 t	1,000,000 t	800,000 t	300,000 t	350,000 t
Annual Throughput Capacity	5 million t	15 million t	20 million t	14 million t	5 million t	26 million t

Source: Private communication from S. Kubota, Toyomenka (America) Inc., dated May 27, 1983.

Where PV_0 is the present value, S_i is the value of net benefits or net revenues attributable to in the year t to the investment under consideration (calculated as of the end of the year), i is the discount or interest rate per annum, and n is the last year in which the investment has any effect. A financially feasible project is defined as one that generates revenue sufficient to cover all financial costs to be paid, including such transfer payments as taxes. Both economic and financial feasibility is considered in this assessment.

Each benefit, cost, receipt or payment was counted when actually received or incurred and, following a generally accepted procedure, no adjustments were made to allow for anticipated changes in the general price level. The essential principle is that the entire comparison of costs and benefits or revenues should be calculated using dollars of constant purchasing power of some convenient period. Thus, all estimates are in 1980 dollars and are summarized in Table 1.14.

The choice of proper discount or interest rate is subject to a considerable debate. To allow for differences in opinion and for differences in risk premium, the calculations of present value were made using 10%, 12% and 15%. The estimated present values are shown in Table 1.15.

According to these estimates, the CTC is clearly an economically feasible project, i.e., when considered globally the benefits exceed the resource costs by a wide margin. It is also a financially feasible project, i.e., the revenues it generates cover its costs if the CNMI ground rent and other taxes are assumed to total \$5 million per year. If the CNMI ground rent/taxes are \$10 million per year, the project becomes marginal. Furthermore, the present value estimates for net revenue streams are very sensitive to relatively small changes in cost estimates. Therefore, a more comprehensive effort is needed to refine cost and revenue estimates before a more definitive conclusion regarding the financial feasibility of the CTC can be drawn. Overall, however, it appears that the proposed project has merit and that the full scale feasibility study is warranted.

Table 1.14

Summary of Benefits, Costs and Financial Charges

	Year Received or Incurred			
	First Year	Second Year	Third Year	Annually 4th through 28th Year
	(M $ U.S.)			
Benefits:				
Savings due to use of large vessels	0	0	0	32
Savings on storage of stockpile	0	0	0	4
Other non-user benefits	1	1	1	1
Costs:				
Construction Costs	12.5	17.5	20.0	0
Operation Costs	0	0	0	9
Revenues and Financial Costs:				
Transshipment Charges ($2.25 per ton)	0	0	0	2.25
Storage Charges ($0.50 per ton)	0	0	0	2
CNMI Ground Rent/Taxes	0	0	0	5

Table 1.15 Estimated Present Values of Net Benefit and Net Revenue Streams by Discount Rate

Discount Rate (Percent)	Net Benefits	Net Revenues	
	(M $ U.S.)		
10	116.0	30.8*	13.7**
12	89.0	19.3	5.3
15	60.5	7.36	-3.2

*Assuming CNMI ground rent/taxes - $5 million per year.

**Assuming CNMI ground rent/taxes - $10 million per year.

2

Recommendations

RECOMMENDATIONS

Based on the findings of this study, it is strongly recommended that the Governor of the CNMI should take the following steps to verify the economic and engineering viability of a coal transshipment center on one of its islands. There is every indication that segments of the private sector would be supportive of steps one and two.

1. Identify and contract a coal/port consulting firm with experience in Australia, Japan and the United States to conduct the following tasks:
   a. Verification of coal trade and market opportunities in the Pacific Rim countries;
   b. Based on economic and engineering assessment, select a site for a coal center and provide detailed cost estimates and engineering drawings for channel, port, handling, storage and blending infrastructure.
   c. Conduct an in-depth economic/engineering assessment of secondary industries, such as cement, ammonia, desalination and agriculture.
   d. Assess the economic, engineering and environmental viability of coal-fired power systems for the islands as a result of the Coal Transshipment Center.

2. Contract an independent firm or government agency to carry out both environmental and social impact assessments of a coal center and secondary industry as a result of the center in CNMI.

3. With the results of the first two tasks, assuming that they are positive, solicit and negotiate financing jointly from the U. S. Congress, the Japanese power industry, and the Australian coal industry.

4. Develop land lease agreements and tax incentives that will provide revenues for the CNMI government and also be comparatively advantageous and beneficial enough to attract outside capital and investment in CNMI.

TECHNICAL REPORT

3

Introduction

INTRODUCTION

PROBLEMS AND CONSTRAINTS

Problem statement: The CNMI, as a newly emerging self-governing entity, is aggressively pursuing a society where decisions as well as revenues for the running and maintaining of government and other public and private services can be locally generated and controlled. There are, however, a number of constraints that the CNMI government is currently faced with and it is investigating various means to overcome them. The major ones are:

1. Natural Resources: Land, a precious commodity limited to a total of 184.51 square miles, of which 47.46 square miles are on Saipan where close to 90% of the population resides. Water, especially potable water, on Saipan is obtained from underground water lenses. This impedes the development of agriculture, urbanization and commercial activities that require large quantities of fresh water.

2. Economic Base: The government is the largest single employer, with 27% of the labor force in 1982. As the private sector is still in its early development stage, government is still providing such basic services as health care, water and electricity.

3. Federal Government and Foreign Investment (Table 3.1): Since the CNMI separation from the Trust Territory of the Pacific Islands, federal aid has been increased, which in turn has been accompanied by various federal laws, rules and regulations which in some cases could discourage potential foreign investors. Efforts by both branches of the government, especially the Northern Mariana Islands Commission on Federal Laws, have been undertaken in studying and making recommendations on such legislation as the Clean Air Act, the Ocean Dumping Act, the Coastal Zone Management Act, the Rivers and Harbor Act, the Federal Power Act, the Deep Water Act and the Ocean Thermal Energy Conversion Act.

There are a number of ways to address these general problems. The government of the CNMI foresaw that there is no single or simple solution to employment, transportation, energy, water, agriculture, health,

Table 3.1

NUMBER OF WAGE AND SALARY EARNERS AND
AMOUNT OF WAGE AND SALARY EARNINGS,
PRIVATE AND GOVERNMENT SECTOR, 1977 AND 1982

Sector	Wage and Salary Earners			Wage & Salary Earnings ($000)		
	1977	1982	Change (Percent)	1977	1982	Change (Percen
GCNMI	1,979	1,849	- 6.7	$ 8,024	$17,338	116.1
TTPI	1,411	533	-62.0	8,017	7,078	-11.8
Total Gov't.	3,390	2,382	-30.0	16,041	24,416	52.2
Private	3,617	6,299	74.1	9,655	30,452	215.4
TOTAL	7,007	8,681	123.8	$25,706	$54,868	213.4

Source: CNMI Overall Economic Development Strategy, 1983 training, and housing and so it launched a number of studies, assessments, and economic and engineering feasibility studies. Ports and small harbors, oil storage, fisheries, tourism, alternate energy and coal transshipment studies are but a few. These efforts are being carried out by an interdisciplinary group of individuals, government agencies and private consultants to ensure that engineering, economic, environmental and social issues are weighted equally in the assessments as well as in the recommendations.

BACKGROUND

The continued efforts of the Government of the Commonwealth of the Northern Mariana Islands (CNMI) to stimulate economic development and alternate energy resources and the utilization of the available experts, institutions, and agencies led to a contract for the Research Institute of the Pacific Basin Development Council (PBDC) to carry out a Coal Movement in the Pacific Basin Study. In a letter of May 28, 1982, the CNMI government specified the scope and type of assessment to be done by PBDC.

SCOPE OF WORK

1. Brief history of coal in the Pacific.

2. Identification of present coal-related Pacific shipping routes, shipping companies, support industries, projected traffic and tonnage volumes.

3. Analysis of plans and projects concerning coal movement in the Pacific, with special emphasis placed on those which may be of significance to CNMI interests. The report will discuss related plans and projects of Japan, China/Taiwan, Korea, the United States, Pacific Islands, Canada, Australia, and other island areas.

4. Identification of potential coal uses and associated primary and secondary industries. Primary focus will be placed on those which could reasonably be expected in the CNMI or those regions which might affect the CNMI.

5. Discussion/correspondence with coal industry interests concerning possible opportunities presented by the CNMI's location adjacent to coal movement routes.

6. Short-term, mid-term, long-term future possibilities of coal usage in the CNMI.

7. Identification of demands on CNMI resources (including financial, natural, physical and human) from primary and secondary coal-related activities (e.g., land size and type, port and harbor, utilities, government services, labor, etc.).

8. Identification and evaluation of the positive and adverse economic, social and environmental impacts. A discussion of the impact of coal usage upon development of indigenous energy sources will be included. Special attention will be paid to imports which the CNMI could reasonably expect.

9. Regional issues and opportunities for regional cooperation.

10. Summary Report of Findings.

STUDY OBJECTIVES

There have been numerous studies in the U. S. territories, and CNMI in particular, and, as some officials have said, "We have been studied to death." In formulating the study approach for the Coal Movement Study, five objectives were identified in the earlier stages of the work, so that as it progresses, it will not lose sight of what the CNMI government wanted. The objectives are also essential to the direction and justification for future detailed economic, engineering, social, and environmental feasibility studies of coal transshipment and potential use in the CNMI. This type of analysis will prevent the expending of limited manpower and funds on the early scoping of the assessment; it will also provide a more reasonable and efficient method of further analysis if this first phase indicates some potential economic benefit in coal transshipment in the CNMI.

Following are the stated study objectives:

1. To verify the economic, engineering and environmental viability of coal transshipment in the CNMI.

2. To identify the potential economic benefits of coal transshipment.

3. To assess the economic trickle-down effect of coal transshipment.

4. To identify and validate the economic, engineering, and environmental viability of coal utilization in the CNMI.

5. To establish/reject the need to conduct a detailed engineering, economic and environmental analysis of coal transshipment and coal utilization in the CNMI.

STUDY APPROACH

Coal transshipment is a multi-function activity, and it requires an integrated approach. Transportation, engineering, economic, environmental, and social factors must be evaluated and correlated. In addition, a number of individuals, institutions, and government agencies in the past have studied the potentials and the resource availability and need for the various factors. To integrate the expertise and the findings, the Research Institute of PBDC, through the Project Coordinator, contracted as consultants a coal mining engineer and a transportation economist, and secured the assistance of the U.S. Army Pacific Division Corps of Engineers (letter of September 3, 1982) in the study. Each of the four participants is responsible for a specific part of the study.

Following are summaries of the responsibilities of the parties:

PBDC:	Project coordination, development of the recommendations, compilation and storage of data, and the preparation of the general narratives. It will also provide liaison between the investigators and the CNMI government.
Coal Consultant:	Development of the section on transportation, handling, storage and utilization of coal.
Transportation Economist:	Assessment of the economics of coal transshipment, the labor requirements, generation of secondary industry, and competitiveness of transshipped coal.
Corps of Engineers:	Calculation and provision of preliminary design criteria for harbors and channels that can handle large vessels.

This approach gives a wide access to the latest plans, technologies and regulations that could impact the transshipment and utilization of coal in the Pacific Basin.

ISSUES AND CONCERNS

While it might at first glance look attractive and logical, close evaluation of coal transshipment raises a number of issues and concerns. Though the study is not structured to provide answers to each of these issues, it is believed that the investigators should at least be cognizant of them. The list could be expanded, but for the purpose of generating awareness of the alternatives and potential impacts of coal transshipment, the following issues will be sufficient. This itemized list also forms the foundation of our inquiries in this study.

1. The Northern Mariana Islands are not located in the most direct shipping lanes for Canadian or U. S. coal. However, they are close to existing Australian and potential New Zealand coal routes.

   a. Why would shipping firms reroute their ships through the Northern Mariana Islands?
   b. What are the additional costs of bunkering and resupplying coal ships in the Northern Mariana Islands?
   c. What are the potential benefits to the Commonwealth of the Northern Mariana Islands?

2. The Northern Mariana Islands are located in a Pacific Ocean typhoon zone.

   a. What degree of safety and/or protection can be assured or provided if it is determined that this type of weather condition will have an adverse impact on the coal carriers?
   b. How much impact would adverse weather conditions have on the scheduling, arrival and departure of ships, and the loading and unloading of coal in the Northern Mariana Islands?

3. The channel depths of the Saipan, Tinian and Rota Harbors are about 30 feet; normally, 50,000 dwt vessels, which draw about 40 feet of water, are used for coal shipments. For transshipments of coal, 100,000-200,000 dwt ships are being considered.

   a. With the Federal Government's emphasis on full (100%) local financing of port construction and possibly of operations and maintenance (including dredging), how will the Commonwealth of the Northern Mariana Islands obtain sufficient funding for the additional construction and maintenance costs if these (larger) coal ships are used?

b. If one of the major functions of rerouting to the Northern Mariana Islands is for stockpiling and transshipment purposes, how can the needs for deeper and larger ports, larger turning basin areas and facilities, and larger stockpiling areas on shore be met?

4. Guam was recently approached by a private interest to provide bunkering facilities to refuel commercial ore and coal carriers. However, it should be noted that the Territory of Guam government has not shown any official interest in actual coal transshipment.

   a. What impact, if any, would the potential Guam venture have on the potential transshipment and storage operations in the Northern Marianas?
   b. What economic, political, environmental, labor and other resource advantages does the Northern Marianas have over Guam?
   c. Can such large ships be refueled in the Northern Marianas?
   d. Will the existing oil supplier (Mobil Oil/Micronesia) be willing to expand its services to accommodate these potential new clients?

5. Coal dust pollution, run-off, and leaching into the water lense are of great concern to the Commonwealth of the Northern Mariana Islands.

   a. What reprocessing and/or enhancing of coal can be carried out in the Northern Marianas?
   b. What additional resources, facilities and manpower would be required by these activities?
   c. Can these additional resources, facilities and manpower be obtained in the Northern Mariana Islands?

d. Given that past experiences have shown that island sentiments are against oil storage and nuclear waste dumping, what would be the feelings of the CNMI citizens and government regarding coal storage?

e. Would there be any change in the attitudes if there were some direct benefit from the use of raw and/or processed products in economic development activities?

6. China and the Soviet Union are potential suppliers of coal. In fact, Japan is providing financial and technical assistance for coal production to China so that Japan can import the China coal surplus.

   a. If the demand for U. S., Canadian and Australian coal diminished after the Northern Marianas ports were expanded to accommodate coal ships, what other uses for these ports would there be?

   b. Would end users allow their coal supply to be tied or further controlled by the United States by its stockpiling in the Northern Mariana Islands?

7. Currently, there is a significant foreign labor force being imported to provide construction, maid services, bar-restaurant services, and to do other semi- and skilled work on Saipan. This has resulted in a lesser rate of retention of new capital in the islands.

   a. Would increased coal activities increase the demand for foreign labor?

8. In general, steam coal (for power generation) is in higher demand than metallurgical coal (for ore smelting), although Japan's interest in both types must be taken into consideration.

a. Besides electrical power generation, what other primary and secondary uses can be identified?

9. Elected officials in the Commonwealth of the Northern Mariana Islands have requested termination of the U. S. trusteeship of the Trust Territory of the Pacific Islands as soon as possible. Upon termination, certain Federal laws which have not applied to the Northern Marianas in the past will become applicable. The application of the Jones Act will bar foreign vessels from carrying cargo between American ports. Current reports indicate that most bulk carriers are non-U. S. vessels.

   a. What impact will the termination of the trusteeship and concomitant application of certain previously nonapplicable Federal laws have on potential coal movement to the Northern Marianas?
   b. What impacts would post-trusteeship application of Federal trade and tariff regulations (and fees) have on potential coal transshipment activities in the Northern Marianas?

10. Japan is diversifying its coal sources so that strikes and other delays will not interrupt a constant, reliable flow of coal to Japan.

   a. What are the implications of unionized labor, strikes and other operational disruptions for the use of coal facilities and services in the Northern Marianas?
   b. What potential is there in the Northern Marianas for preventing strikes and other operational disruptions which would impact constant, reliable shipment of goods from the Northern Marianas?

DESIGN STUDY CRITERIA

The flexibility and the possible large combination of vessel sizes, channel depths, coal throughputs, different harbor sites, and many other variables require that a set of design study criteria be selected. The channel depths and vessel characteristics chosen are hypotetical but correspond closely to the existing coal vessels from Australia. The throughput is based upon the coal consumption of Japan and the current load/unloading capacity at Pier G at Long Beach Harbor.

Three potential sites have been designated, based upon the U.S. Army Corps of Engineers' reconnaissance studies of 1980: Tanapag Harbor on Saipan, Rota Harbor on Rota, and Tinian Harbor on Tinian. Tanapag Harbor improvement/expansion costs will be done for three different depths (40, 50, and 60 feet) to accommodate vessels of dead weight tons (dwt) ranging from 50,000 to 150,000. Rota and Tinian will be limited to 50,000 dwt only.

On stockpiling for transshipment, calculations (Hicks: 1972: 3 - 363) will be limited to 1,500,000 metric tons' storage capacity with the assumption that transshipment will not permit the total throughput of 3 mt to be stored at one time.

4

Existing Conditions

EXISTING CONDITIONS

The on-site evaluation and assessment is an essential component of the Coal Movement in the Pacific Basin Study. As the engineering, economic and environmental analysis is being carried out in Honolulu, Hawaii, the existing conditions (i.e., social, political, economic, and environmental) on Saipan, Tinian and Rota had to be validated. To bring reality to the study, the on-site visit tried to evaluate and assess the following:

1. The conditions and future plans for harbors, ports, on-shore facilities;
2. Land availability and policies;
3. Labor needs, regulations, union movement;
4. Economic conditions - role of transshipment in the long-range economic goals;
5. Power plants - conditions, operation and maintenance costs, and potential use of coal and its impacts on environment and renewable resources developments;
6. Acceptability of coal transshipment and utilization - political, social and environmental;
7. Barriers/impediments to coal transshipment and utilization - technical and social; and
8. Pre-selection of potential sites - criteria and rationale.

GENERAL CONDITIONS

One method of visually assessing the conditions of the ports, harbors and channels was to ride the Marianas Queen, a ferry boat which went from Saipan to Rota and returned via Tinian.

Saipan

Current reports and visual inspections show that the Charlie Dock on Saipan is experiencing deterioration due to age, typhoon waves, and other corrosive environment (Figure 4.1).

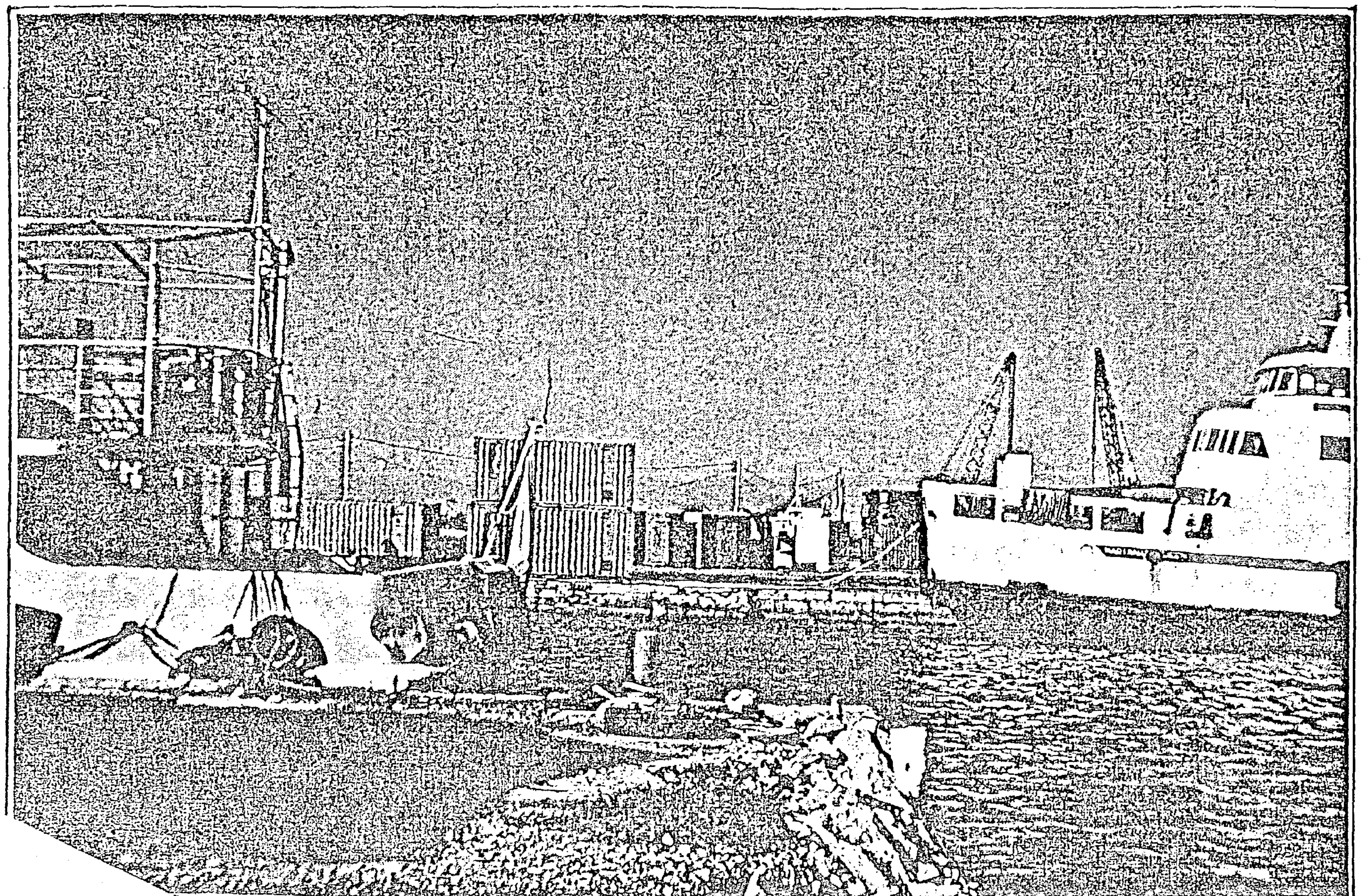


Photo: Actouka '82

Dock and Marianas Queen, Saipan

The ferry boat had no trouble maneuvering in the turning basin and the channel, as it is the main port of call in the Northern Mariana Islands.

Space on Charlie Dock is not available, and the nearby shore area is being considered for other port-related activities that will prevent, and not be compatible with, coal stockpiling (Figure 4.2). Some officials feel that the adjacent lands, flat and non-productive now, should be turned over to the Port Authority. This might prove to be a potential site for coal stockpiling. The most accessible area, "dump site", is under the U.S. military retention area. Again, some officials believe that it could be used for transshipment, as it is port activity-related.

Power, sewer, water, telephones, and roads are accessible, and no major utilities expansion/extension would be needed for transshipment requirements.

A master plan for the port and nearby land is underway, but so far the draft has not yet been accepted by the CNMI government.

A second potential site is the sea-ramp area by the new power plant. The U.S. Army Corps of Engineers has completed a master plan for a small boat harbor for the site. Currently, no funds are available to implement this plan, and the docks are deteriorating and grass and small trees are overtaking most of the seaplane landing.

Because the areas from the seaplane ramp to the new power plant and the repair shop and old TTPI warehouse have been filled in and concreted, it is not suitable for agriculture. Production is limited to services and repairs. Some officials feel that it should become the center for light industries (e.g., block making, auto repairs, etc.). Again, it was pointed out that if coal stockpiling at this area would generate more revenues and employment, a reassessment and change of priorities could be made.

An additional attractiveness of this location is the close proximity of the dock to the plant. If the CNMI were to opt for steam generation in the future, the cost of coal would be relatively low; for land transportation the cost would be minimal.

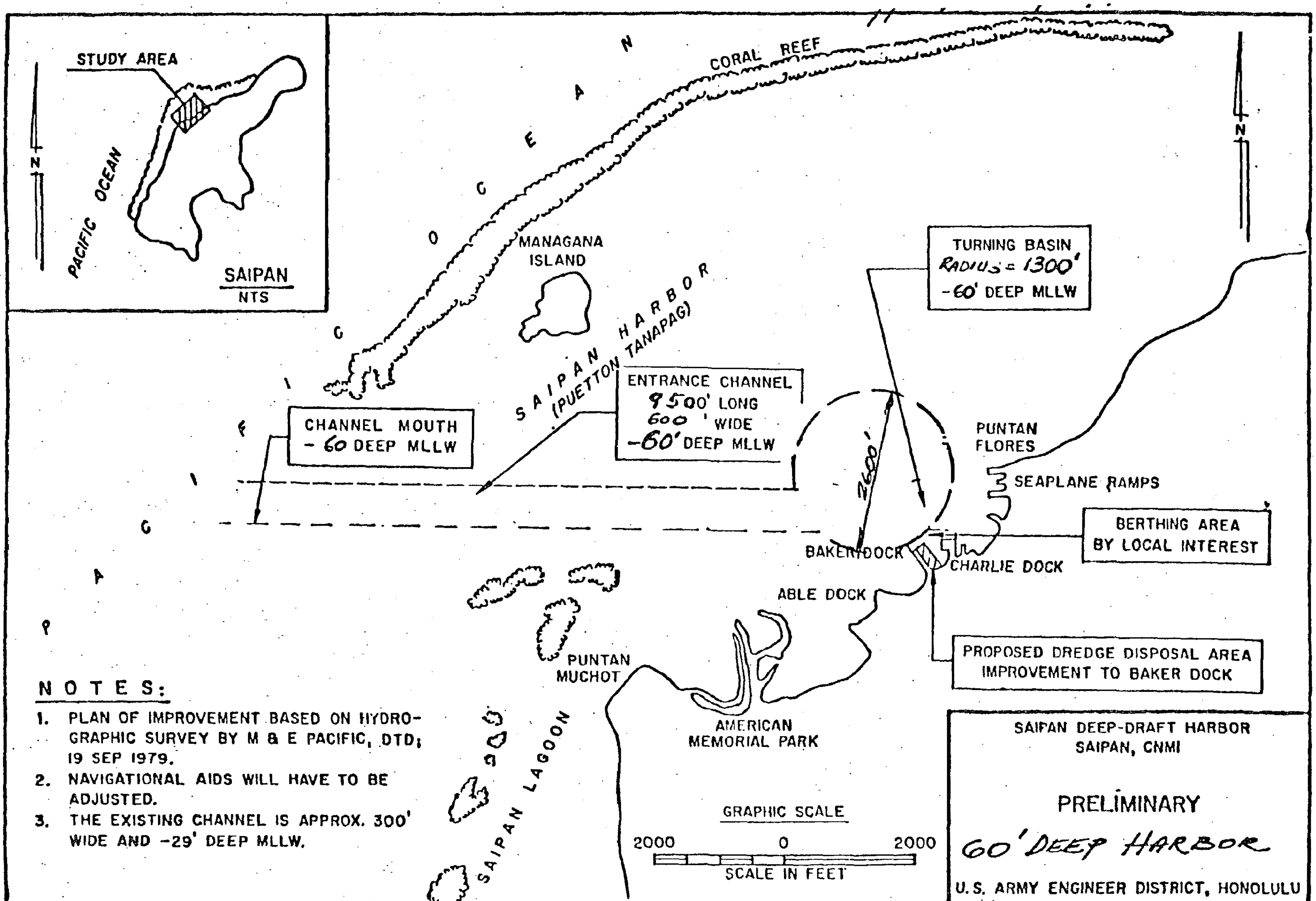


Figure 4.2 Saipan Harbor Improvement Cost at $75 million for 60 feet draft

A well-placed and technically competent official supported the stockpiling of coal on a reef-flat adjacent to the power plant with dredged canals as berms. This idea is being tried along the Atlantic Coast. Environmental and economic detail analysis has yet to be done, and if and when it is, this would be the last option for CNMI.

A proposed small boat harbor is being planned for the Japanese seaplane ramp adjacent to the new power plant. Sources indicated that currently there are no funds to construct the facility. If it is constructed, with the deepening of the channel there is an excellent possibility of delivery of steam coal for power generation to the site. Major coal shipping companies are using conveyor type self-unloading bulk carriers to ship and transfer coal from a vessel to non-improved sites. Ship-to-land conveyors can be as long as 250 feet. Close working relations between CNMI, the Army Corps of Engineers and coal shipping companies have to be established to phase in the objectives of power generation, docking facilities and vessel designs.

Rota

Currently, Rota West and East Harbors have few natural depths and protections (Figure 4.3). Small ships, such as the Marianas Queen, a small draft river-type ferry, have difficulty in entering, exiting, turning around and docking at the West Rota Harbor. Recently, however, the U.S. Army Corps of Engineers has contracted the International Bridge of Guam to deepen and widen the channel, construct docks and a causeway connecting the existing island of Anjota to the mainland.

During the site visit, it was verified that there were no warehousing and handling structures at the dock. Most small cargo is handled by forklifts onto trucks and pickups.

Land adjacent to the dock is already occupied by some houses and a small diesel power plant. Nearby lands, some still undeveloped, are high and are already being dedicated to housing, as it is close to the center of town.

The East Dock is basically an open non-wave protected jetty. It is deteriorating as a result of its exposure to the bay and open ocean and the regular typhoon forces and damage.

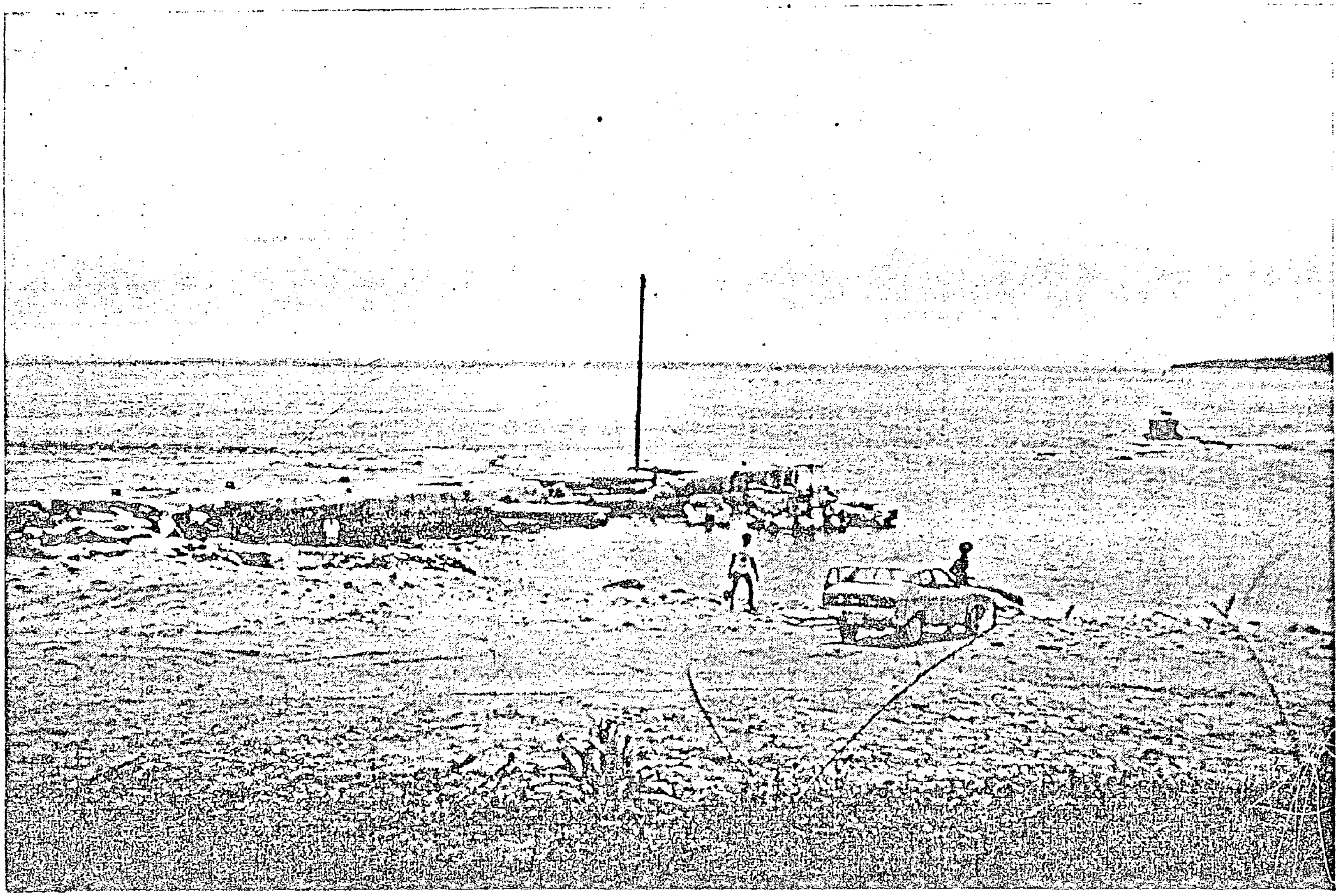


Photo: Actouka '82

Figure 4.3 East Dock, Rota

The adjacent land is limited by the residential, school and recreational facilities already in place.

Both the West and East Dock/Harbors at this time do not have the required channel depths, turning basins and land area to accommodate (approximately 5 million metric tons of coal per year) coal for transshipment to Japan and other Pacific Basin and Rim countries (Figure 4.4).

However, with the use of self-loading coal vessels, the U.S. Army Corps of Engineers' development of West Harbor, could improve the role of Rota in coal transshipment in the future.

An opportunity that could impact the possible development of a coal transshipping port on Rota is the interest of Northville, an oil company, to construct a major oil transshipment facility in the CNMI. Rota is being considered as a possible site. The exact location of the facility is further up on the northern end of the island. Some drawbacks of the site include the lack of existing infrastructure (e.g. dock, harbor, housing), roads and utilities. Northville's decision is expected sometime toward the end of this year.

The recently completed airport and terminal will provide easy access to Rota. The road construction from the airport to Songsong Village is progressing well. Power, water, and sewer, however, are not being extended to the airport and the new housing division between the airport and the town.

The Mayor of Rota, Prudencio T. Manglona, and other elected leaders are supportive of labor- and revenue-generating projects for two major reasons. First, most employed people are working for the government; and second, as job opportunities are limited on Rota, there is a strong out-migration to Saipan, Guam and other areas.

Coal transshipment is looked upon as a potential incentive to turn the tide of out-migration, and as a trickle down effect, to improve commerce, tourism and agriculture. Currently, there are only two hotels (PauPau and the Blue Peninsula).

In contrast to Saipan, fresh spring water is available on Rota. Large public land areas have not all been designated for specific uses, but are too far from the docks, and elevations are too high for single conveyors to transport, reclaim, and stockpile coal.

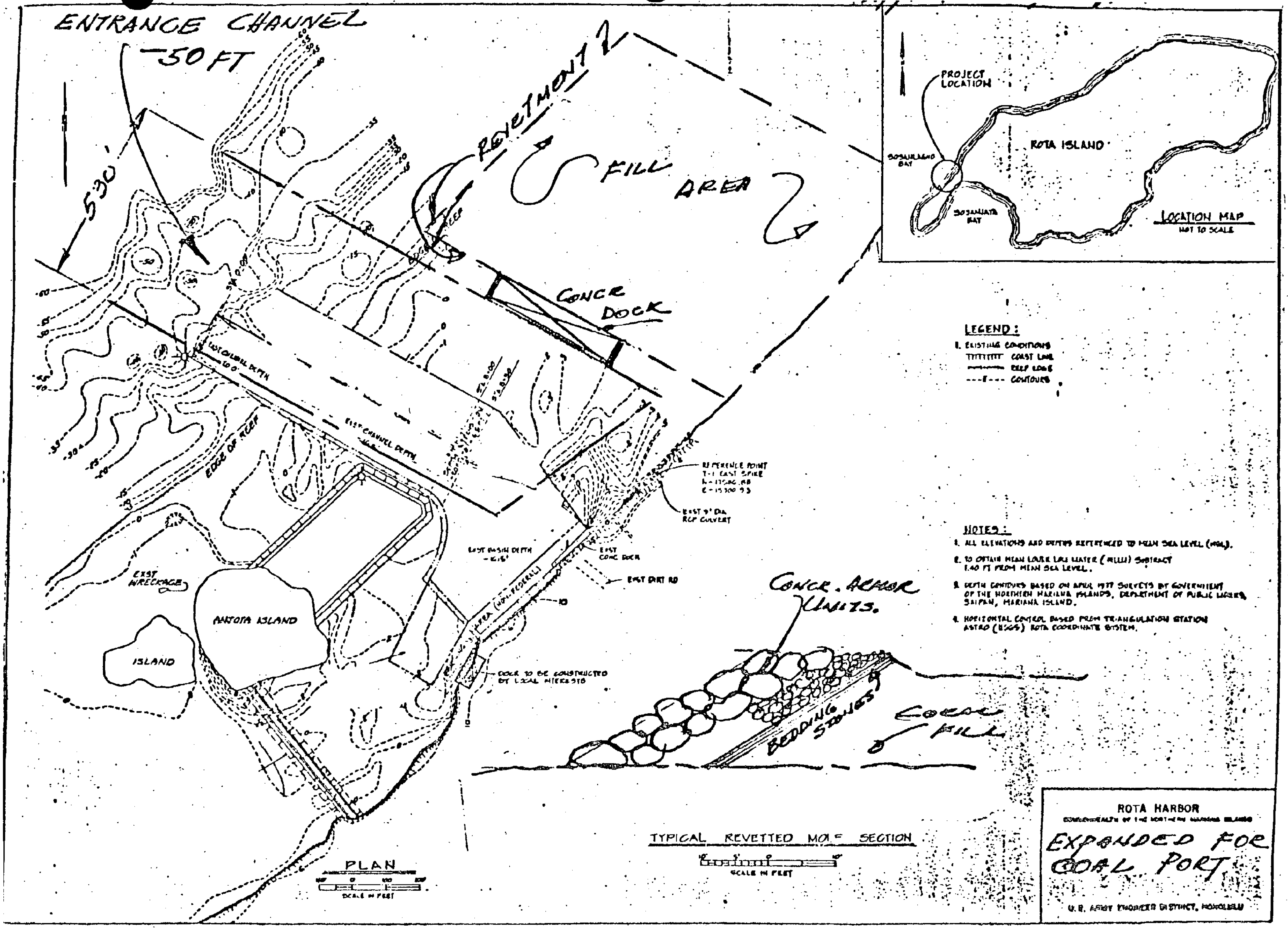


Figure 4.3 Rota Harbor Improvement Cost at $4 million for 50 feet draft

Tinian

The use of Tinian Island during World War II by the United States as a support base for B-29's that dropped the atomic bombs on Japan has resulted in an excellent paved road, airfields, and the existing dock and harbor.

Two site-visits to Tinian, first by ferry boat Marianas Queen and by small six and two-passenger planes, revealed the excellent conditions of the channel, wave-breakers, docks and piers. Most of the adjacent land has not been developed and is still overgrown with pine trees and bushes. Though the power plant is less than a mile away, there are virtually no structures (warehouses, cranes, or repair shops) presently located at the dock.

For purpose of coal transshipment, Tinian is ideal. Large harbor and port with potential expansion areas exist. Land is available at close proximity and with low elevation.

A major potential problem is the U.S. Department of Defense's lease option for Tinian. It was established in the CNMI Covenant. The lease option will require the use of 18,182 acres which will include a good portion of land and dockage area of Tinian Harbor. The U.S. Congress recently, after some delays, appropriated $32 million for the lease option. However, officials, especially of the Marianas Public Land Corporation, believe that there is a provision in the agreement for joint use of the land as long as there is no major conflict. This has to be legally and environmentally assessed when specific DOE and coal transshipment plans become more developed.

ELECTRIC POWER GENERATION AND TRANSMISSION SYSTEMS

On all of the islands in the Commonwealth of the Northern Mariana Islands (CNMI), diesel is the main fuel source for the power plants. The government owns, operates and maintains the power systems. The responsibilities are carried out by the Utility Agency within the Department of Public Works.

Diesel fuel is supplied mainly by Mobil Micronesia, Inc. (Figure 4.5). Contract provisions, however, have not been disclosed. A bulk plant is located on Saipan.

The Utility Agency is charging customers 6-7 cents per Kwh, depending on the level and type of use, while it is estimated that power generation costs alone are 7.2 cents per Kwh. To rectify this imbalance, the CNMI government is seeking qualified contractors to:

1. Design rates for electric power customers;
2. Calculate the total amount of revenue that must be collected by the Utility Agency; and
3. Determine the effects of current and proposed rates on conservation efforts.

Saipan Power System

The main power plant is located at Lower Base. It started regular operations in May 1980. It has three Mitsubishi-Mann generators with the capacity of 7.2 MWe each at 13.8 kilovolts. A fourth generator will increase the total capacity to 29.2 MW by September 1983.

Projections from various studies for power demands for 1983 vary from 18 to 20.3 MW. The standby power plant has two 1,500 KW White-Superiors and two 2,856 KW Norbergs. They are constantly under various degrees of repair/maintenance which has prevented a 100% reliability of power supply to the island power system. Recent reports show that with the main power plant utilizing heavy fuel (RFO) and the old plant high grade diesel, the conversion of fuel to electricity or the efficiency difference is close to 7.0% in favor of RFO. (Table 4.1)

Table 4.1 Efficiency Rates of Saipan Power Plants

	Heat Rate	Efficiency
Main Power Plant	8,570 Btu/Kwh	39.8%
Old Power Plant	10,340 Btu/Kwh	33.0%

NOTE: Heavy Fuel Oil 138,778 Btu/Gal
Diesel Oil 127,185 Btu/Gal

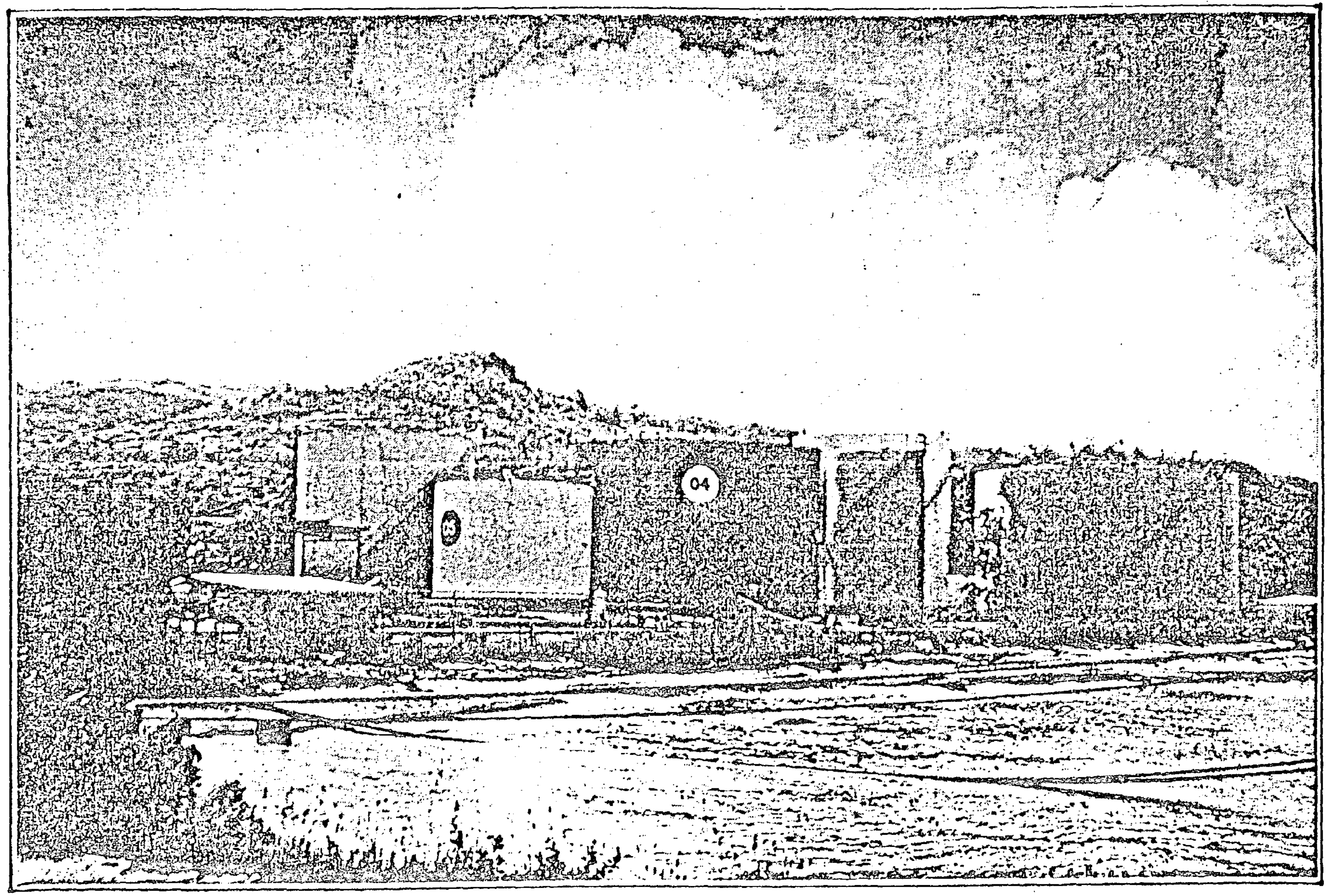


Photo: Actouka '82

Figure 4.5 Mobil Bulk Plant, Saipan

Power demand is increasing at a rate of about 10% each year.

Power plant operation costs are forecast to be about $7.7 million. The actual costs will be less because of the oil glut of this year. For the next fiscal year, the government has budgeted about $7.2 million out of a total budget of $44.8 million.

Tinian and Rota Power Systems

Both islands have smaller land areas and out-migrating populations (mostly to Saipan and Guam) than Saipan. The power systems are small diesel systems (Figure 4.6). For example, the Tinian power plant has two 600 Kw White-Superiors and two 300 Kw Caterpillars. During my visit there, it was observed that some of the generators are down and need major overhaul. In the process is the purchase of a 1,000 Kw Yamaha generator from Japan. This, as in the past, will create problems in operations and maintenance. Spare parts will be expensive and cannot be exchanged among the three different manufacturers. Past experiences have shown that spare parts from Japan are usually hard to secure on a timely basis.

The elected officials, both on Tinian and Rota, are trying to institute ways to encourage commercial activities on their islands. But with limited power capacity and reliability, it is imperative that fuel sources are identified and incentives given to potential energy ventures.

Power and Coal Storage Scenarios

In considering coal transshipment, two major resources are essential: flat land close to port and a good harbor. If these conditions are met, an additional benefit of coal transshipment is the use of coal for power generation. Tinian, at this early stage of the investigation, has excellent land and a good harbor that can also be expanded. The government officials and the businessmen on Tinian are in support of the coal transshipment proposal.

Two scenarios are economically and technically possible to enhance the power systems on Saipan and Tinian. First, coal can be transshipped from Tinian to Saipan on smaller barges or by self-unloading carriers to

Photo: Actouka '82

Figure 4.6 Rota Diesel Power Plant at West Dock the site of the main power plant. Second, and meritorious, is the construction of a larger steam power plant on Tinian where coal is (assuming that Tinian is the stockpiling site) already available and a strong need for power could increase with military use of the lease option. A 50 MW power plant could support Tinian and Saipan power needs.

Submarine direct cables have been used in up to 1,800 feet of water. The State of Hawaii is currently working on submarine electrical cables and will further enhance the electrical and mechanical capabilities of D.C. submarine cables. Of particular interest to this project are the works of the Hawaiian Electric Company., Parsons Hawaii and the State of Hawaii Planning and Economic Development.

5

Coal in the Pacific

COAL IN THE PACIFIC

This history is derived from research on the industrial use of coal in the Hawaiian Islands, the Northern Marianas, Guam and Japan. A limited amount of material was found on coal imports to Hawaii in the period from 1850 to 1945, very little information is available on coal in the Northern Marianas and Guam, and extensive information is available on coal imports to Japan since 1940. The Japanese history is important since it is the background of the present and future dominant sector of the Pacific coal trade.

HAWAII

Introduction of coal in significant quantities into Hawaii coincided with the mechanization of the sugar industry by the introduction of the centrifuge and the import of Scottish sugar machinery in the early 1850's. This equipment required drive lines, steam engines and boiler plants. Cane was gathered from the fields and transported to the plants on narrow gauge railroads with small, coal-fired locomotives.

Steam-powered ships were also introduced into the island trade about this same time. The world's navies were also being converted to steam and required coaling stations to ensure their mobility.

The earliest source of coal was as ballast in sailing ships en route from the Pacific Northwest to the orient. Later, a lively trade developed in hauling lumber from the Pacific Northwest to Australia and backhauling coal to Hawaii. A coal discharge dock was built in Honolulu by the Oahu Railway and Land Company in 1890. The U.S. Navy opened a coaling station that was later upgraded to a Naval Station known as Pearl Harbor. The importance of the coal trade is evidenced by its inclusion in the Reciprocity Negotiations of 1848 between the Kingdom of Hawaii and the United States.

The Hawaiian Electric Company opened its first coal-fired generating plant in 1894. Coincidental to the peaking of the coal trade was the development of the Signal Hill oil field in Southern California and the

Union Oil Company's search for markets. In 1903 three of the largest sugar plants on Oahu agreed to use oil in place of coal. The Union Oil Company introduced the progenitors of the modern tanker fleets to serve this market. By the end of World War II in 1945, the conversion of coal to oil-fired plants and ships reached the point where coal was no longer imported.

The OPEC oil embargo and the higher price structure for oil occasioned a review of energy sources in Hawaii starting in 1973. The studies proceeded slowly for several years, until the cement plants were threatened with serious price competition from west coast plants which had changed over to coal under Federal orders. The cement plants completed their refit to coal in 1979.

The Hawaiian Electric Company commissioned a study by the Stearns-Roger engineering firm in 1978. The study developed the conclusions that the use of coal in Hawaii was feasible from a "logistical, technical and operational standpoint". The study cautioned that "The environmental and economical aspects need additional study as their potential impact on the Hawaiian Islands is considerably greater than for most any other area of the United States."

The study goes on to point out that at the then cost of (Colorado) low sulfur, washed coal delivered to Oahu of $2.44/MBtu, coal was competitive to the then cost of oil on the same basis or $2.57/MBtu. Current estimated cost of coal on the same laid-down basis, but using washed Australian low sulfur coal is $2.50/MBtu. The average HECO fuel cost for oil in 1981 was $6.59. It should be noted that the plant described in the Sterns-Roger study would meet the same emission.

GUAM AND THE NORTHERN MARIANA ISLANDS

Coal usage in other Pacific Islands has been difficult to establish. There seems to have been almost no industrial development during the Spanish occupation of the islands. After cession Guam received scant attention by the U.S. until just before the start of World War II. At that time there were plans to send the USS Gold Star to the Philippines to bring back a load of coal for the power house and for local business houses. (Paul Carano, 1964).

It is likely that during the intensive agricultural development that took place during the occupation of the Marianas by Japan, coal may have been used on the cane railroads or in the sugar plants (Table 5.1).

Coaling stations established by the U.S. Navy were located at the following ports:

Philippines: Olangapo and Cavite
Japan: Yokohama
Guam: Apra
Alaska: Sitka
Hawaii: Honolulu
American Samoa: Tutuila.

JAPAN

The largest volume of coal trade in the Pacific has been to meet Japanese import requirements for their steel industry. Table 5.2 shows the principal suppliers of coking coal to Japan from 1940 to 1980 and the rounded quantities supplied.

The flexibility and skill with which the Japanese procurement policy was implemented are indicated by the fact that the major part of imported coal is from coal fields not in production before 1955. These coal fields and the necessary infrastructure were financed internationally with minimum Japanese funds. The installations are modern and efficient and have resulted in very competitive prices. The Japanese government controlled the procurement program through MITI in a manner that prevented the users from competing for the supplies and bidding up the price. When the vendors' governments tried to equalize the negotiating process or increase the cash flow from the sale of their resources, the Japanese shifted or threatened to shift their procurement sources.

Japanese domestic coal production reached a level of 56 Mt/y during World War II. Production fell to 20 Mt in 1946, gradually increasing to 55 Mt in 1965. Since then, production has steadily declined to the 20 Mt/y level which is expected to be maintained for the next 20 years.

Table [illegible]1

Coal and Petroleum Imports Into Mariana, Caroline, and Marshall Islands During the Japanese Administration (1917 - 1935)

Year	COAL			PETROLEUM			
	Value	Quantity		Value	Quantity		
	Yen	Pounds	Metric Tons	Yen	Litre	Gallons	Barrels
1917	---	---	---	17,211	---	---	---
1918	---	---	---	30,800	---	---	---
1919	---	---	---	26,061	---	---	---
1920	---	---	---	20,344	---	---	---
1921	900	---	---	16,622	---	---	---
1922	68,507	---	---	32,659	---	---	---
1923	68,292	---	---	30,884	---	---	---
1924	79,362	---	---	81,953	---	---	---
1925	122,632	---	---	79,589	---	---	---
1926	112,666	---	---	61,708	---	---	---
1927	95,646	---	---	75,589	---	---	---
1928	151,066	---	---	104,745	---	---	---
1929	91,327	---	---	46,611	---	---	---
1930	267,764	30,760,000	13,956	66,347	386,000	101,904	1,852
1931	182,767	26,982,000	12,242	82,210	482,000	127,248	2,313
1932	187,118	34,648,000	15,720	79,946	472,000	124,608	2,265
1933	178,586	18,777,005	8,519	107,807	573,022	151,277	2,750
1934	152,992	23,531,645	10,676	131,591	789,281	208,685	3,794
1935	146,465	18,060,095	8,194	151,545	899,693	237,518	4,318

1 metric ton = 2,204 lbs.
1 litre = 0.264 gallons
1 barrel = 55 gallons

Source: Annual Report by the Imperial Japanese Government to the Council of the League of Nations on the Administration of the South Sea Islands, 1936.

Table 5.2 Japanese Coal Imports From Coking Coal Manuals - 1966, 1976, 1981 (000 tonnes)

Year	Manchuria	China	U.S.A.	Australia	Canada	Soviet Union	Poland	So. Africa
1940	741	2,395						
1945	238	262						
1950		531	75			59		
1955		104	2,364	10		85		
1960			4,988	1,194	564	437		
1965		475	6,904	6,620	873	1,149		
1970			25,345	14,749	4,242	2,489	941	
1975			21,227	21,272	10,961	2,860	1,104	193
1980			14,000	26,000	10,000	1,600	400	2,500

The Japanese did not import thermal coal before the oil embargo. Their policy was to increase oil and liquid natural gas imports for use in new thermal plants. After the embargo, the policy was quickly modified and they implemented a thermal coal utilization program. The cement industry and paper and pulp companies have completed their changeover and increased coal imports from nil in 1975 to 8 Mt in 1980. Utilities were less than 2 Mt in 1980 but are expected to increase their imports to 15 Mt in 1985. Total thermal coal imports are expected to increase to 22 Mt in 1985.

POTENTIAL COAL USERS

It is unlikely that a Coal Center could be financed without firm contracts for its services at least through the payout period. To find the client or clients most likely to make long-term contracts for Coal Center services, it is necessary to study the structure of the international coal trade in the Western Pacific. Tinsley (1982) offers the most current and comprehensive information for this purpose.

Construction is underway or committed to in Taiwan and Korea for coal receiving facilities. Coal Centers are being planned for Indonesia and the Philippines. These countries have future domestic mining plans but would initially import coal for their own use and transshipment to SE Asia (Slater, 1982). None of these areas are likely to be markets for coal passing through Tinian.

Japan has the largest expanding demand for coal in the CNMI trade area. Conversion of the cement and general industry plants to thermal coal is well underway. An active program to increase the coal-fired share of power generation from 17,000 GWh 1979 to 96,000 GWh in 1990 is underway. Thermal coal imports for power will exceed the present metallurgical coal imports by 1990.

Metallurgical coal imports are expected to increase from the present 60 Mt in 1981 to 80 Mt by 1990. The deep draft and well-equipped ports of the coking coal importers now unload the largest bulk carriers. These ports are capable of higher throughputs. The higher capacity will be used for associated public utility companies. Metallurgical coal importers are not prospects for a offshore Coal Center.

The Japanese cement industry made the earliest transition to coal. They lifted 8.3 Mt in 1981 and are not expected to import more than 15 Mt by 1990. The high ash thermal coal was landed at existing ports with capacity for increased imports. Other miscellaneous users import less than 2.0 Mt. Cement and general industrial users are not likely Coal Center prospects. The Coal Center would import only low ash, low sulfur thermal coals.

The public utilities of Japan presently import about 5.6 Mt of thermal power coal mostly from Australia. The 1981 Coking Coal Manual is the source of the following data concerning future public utility plans for coal-fired power generation: (Table 5.3)

Table 5.3 Japan's Future Public Utility Plans for Coal Fired Power Generation (Period 1981 - 89)

Use	MW Requirement	Coal Requirement
Construction decided (16 units)	10,350 MW	25 Mt
Construction undecided (20 units)	14,456 MW	32 Mt
Subtotal (36 units)	25,806 MW	57 Mt
General Industries (4 units)	500 MW	2 Mt
TOTAL COAL REQUIREMENT (less 10 Mt domestic)		49 Mt

Shibukawa (1981) offered the following projections to the members of the Senate Subcommittee on Energy and Natural Resources in Washington on December 1, 1981: "The Japanese electric utilities industry plans to start 49 new coal-fired units with a total output of 24,000 MW in the coming ten years. This will require the importation of 40 to 46 Mt of thermal coal by 1990." Tinsley (1982) reports various 1981 projections of 45.50 and 51 Mt for 1990, and 74 to 82 Mt for 2000.

The shift to power generation with coal has serious implications from a supply as well as a delivery standpoint. Japan has experienced frequent and serious supply disruptions of coking coal and iron ore. They are aware that they cannot tolerate an uncertain coal supply for utilities.

They must also obtain the lowest possible cost of coal landed CIF plant site. Since ocean freight is their most controllable cost, they are looking for economies in this area. They have recently joined in the financing of overseas port infrastructure projects. They have also studied the steel ports.

The Japanese steel industry has taken the initiative in the development of bulk carriers in excess of 100,000 DWT and deep draft ports at tidewater steel plants. The steel mills' efficient infrastructure incorporating multiple stockpiles and blending is known and has contributed to Japan's competitive position in the world steel markets.

JAPAN'S COAL SUPPLIERS

Australia is an example of an uncertain supplier of concern to Japan. Australia has large low ash and low sulfur coal reserves, new, efficient mines and a newly constructed infrastructure. Australian coal can easily be the lowest cost coals on the Japanese market; industrial strife has caused frequent severe supply disruptions. The 1981 Coking Coal Manual states that the 1980 disruptions cost the Japanese steel companies $200 million on the 18 Mt of coal involved. This situation has caused Japan to rethink its supply relationship with Australian producers and shift to a diversified supply base.

The United States, which is the major supplier of coking coal to Japan, has only recently upgraded some East Coast ports to reduce congestion (Figure 5.1). The major expansion of thermal coal production in the Western states lacks the infrastructure for export to the Pacific Rim countries. U.S. thermal coal cannot be delivered from the West Coast at competitive prices. West Coast coal could use Tinian Coal Center facilities, especially for blending. When deeper draft ports create traffic for larger than panamax vessels, the coal could be stockpiled for forwarding to the utility company ports which have only 14 m (43 ft) draft.

Canadian coal development has been centered on coking coal. Thermal coal is now being developed. Canadian infrastructure is efficient, with the provincial governments assisting in the development of new resources. Unfortunately, adverse weather and rail grades are serious impediments to the competitive position of Canadian mines. This could

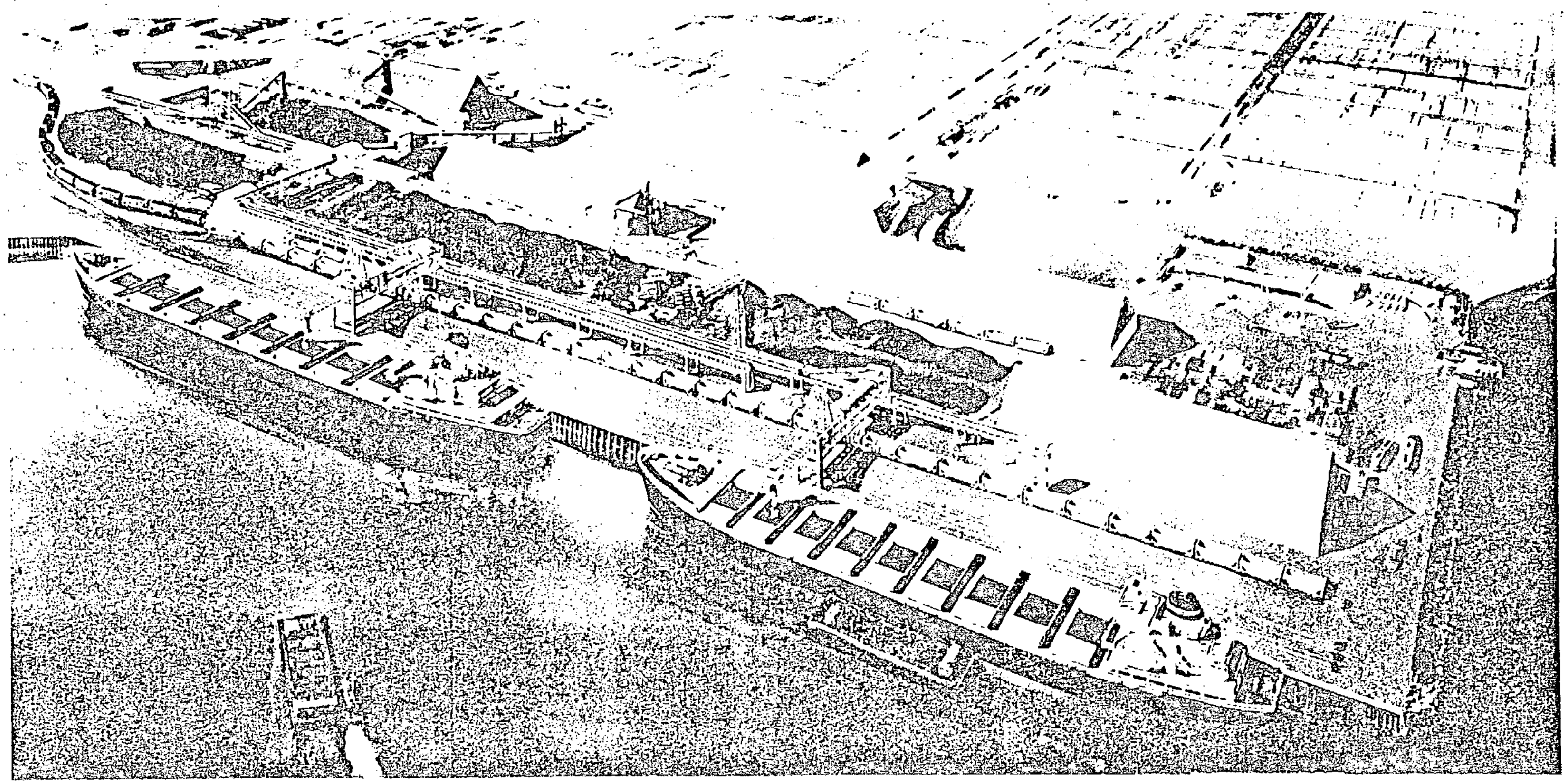


Figure 5.1 Artist's rendering of the Metropolitan Stevedoring Company's dry bulk export terminal on Pier G as it will appear following the expansion program currently underway. Addition of the second bulkloader and increase in the dockside open storage area will double the throughput capacity by early 1983 to some five million tons of coal annually.

be improved in the thermal power coal market by transshipping through Tinian with the large colliers that Canadian ports can load.

THE RECEIVING PORTS

Japan uses stockpiling and diversification of coal sources to counter supply interruptions. Both of these strategies increase the requirements for coal handling equipment and the yard space for storage and blending. Most of Japan's new power plant sites have marginal space for coal receiving, stockpiling and reclaiming facilities. Their water frontage has limited draft potential. More frequent deliveries by smaller colliers will increase the potential for pollution, discharge penalties and higher labor costs. These will create higher energy costs which must be passed on to the consumer.

Japan is now constructing three coal centers for thermal coal (Tinsley, 1982). These centers will be equipped to efficiently receive coal from 100,000 to 150,000 DWT coal transports. They will be designed to handle throughputs of 8.5 to 10.0 Mt/y. They will undoubtably have facilities for blending and reloading coal into vessels suitable for their client's facilities on demand.

Many of Japan's Utility Companies are owned by major chemical and/or metallurgical groups with large coal handling facilities able to handle increased tonnage of power thermal coal. There are many more of the plants to be built that will need facilities beyond the range of the planned Coal Centers and will have to use panamax or smaller colliers from the export ports. These new plants could benefit by using a Tinian Coal Center.

To meet the thermal coal import problem, the Ministry of Transport first considered additional Coal Centers. The heavy expense of centers, the shortage of deep draft harbor sites, environmental concerns and the cost of intracountry distribution have caused a reevaluation of Coal Centers. WESTPO (1981) reports that the Ministry chose 20 out of 61 candidate ports for expansion or development. This program, if completed, has an ultimate capacity for utility coal of 48.7 Mt in place by 1990.

11.8 Mt of this capacity is in operation now. Eighteen (18) Mt is scheduled to be commissioned in 1988/89. Only half of the ports for utility coal planned or existing will berth vessels of 100,000 DWT.

THE NOMINATED USER, JAPANESE ELECTRICAL UTILITIES

Those public utility companies in Japan, existing or planned, that are not serviced by a Coal Center that can receive 150,000 DWT colliers are candidates for a Tinian Coal Center service. Initiatives on behalf of a Tinian proposal are likely to receive favorable consideration by the Transport Ministry. The opportunity to avoid confrontations in expanding ports or opening new ports would be appreciated. A user group would likely be organized by MITI to negotiate for the services of a Coal Center.

The following narrative examines the potential of a Coal Center located on the Island of Tinian, CNMI. The purpose is to determine if the potential opportunity merits in-depth studies. This seems to be indicated by the value to a user of the tangible and intangible benefits. These benefits are of the same order as those at new overseas infrastructures being financed in part by Japanese cooperative funds. A new exporting terminal at the Port of Los Angeles is the most recent example according to TRAK (1982). The financing arrangement is accompanied by a long-term commitment for port operation by a local entity.

It is understood that the citizens of CNMI would only accept the construction of the Coal Center on the basis that it would be environmentally acceptable and economically attractive over the long term.

The greatest potential benefit that a Tinian Coal Center could offer the Japanese group would be to create a significant improvement in the reliability of supply and delivered cost of thermal coal from Australia. The proposed facility should have the inherent capability to obtain the desired benefits:

*A site with potential harbor and ground area located within reasonable shipping radius of the coal ports and the utility ports for optimum transshipping benefits at minimum cost.

*A large ground storage of stockpiled coal to provide emergency backup to Japan-based stock.

*A blending capability to enhance the trading opportunities when attractive spot lots of coal suitable for blending are on the market.

*The blending capability would permit the use of lower quality coals with the normal thermal coal when the combined mix would, through favorable burning characteristics, result in a lower energy cost.

*The high unloading, stockpiling, reclaiming and loading rates would improve the utilization of the collier fleet with resulting lower ocean freight.

The relatively short haul to the Japanese ports from Tinian would permit the possible utilization of self-unloading ships and other innovative shipping ideas. This potential would be of particular importance to the more remote plants with limited land area.

The stockpile would permit scheduling overseas lifting to avoid ports with impending stoppages.

The reader is referred to the article on the new Port Kembla, NSW by Paul Soros (1982). Many of the features of material handling and environmental protection would be appropriate to a Tinian port. This article and other recently published articles by Soros and R. Peckham (1982) provide the basis for some "order of magnitude" estimates of the economics of this facility set out in below: (Tables 5.4 and 5.5)

Table 5.4 Construction Costs of Coal Center, Based on Port Kembla, NSW Data

Purpose	Cost in $ Millions
Site Work	$ 3.0
Marine Construction	8.0
Foundations	3.0
Three Stackers	6.0
Two Reclaimers	10.0
One Shiploader	10.0
Material Handling	10.0
TOTAL	50.0

Note: Soros (1982) states that the Conneaut, OH, terminal charges for railroad unloading, stockpiling and shiploading are $1.19/st of coal. It charges $1.40/st of iron ore from vessel to stockpile to railroad car.

Table 5.5 Annual Operating Costs of a Ten Million Tonne Throughput Coal Center (Estimated)

Purpose	Cost in $ Million	
Capital Charges	$ 6.0	
Operating Expenses	8.0	
General and Administrative	1.0	
CNMI Land Rent	10.0	
TOTAL and (per tonne)	25.0	($2.50)

The later section (Transshipment) points out that the generally accepted criterion for a feasible facility is that the expected benefits exceed the associated costs. And further, that the private benefits in the form of net savings that accrue to the users of the facility will create the demand for its services.

Based on later calculations, it is clear that the size of vessels impacts the cost of transportation from NSW to Saipan (TIN), and to JPN and TIN to JPN. The costs differ in the amount of delay time in NSW harbors. Three scenarios using these tables are set out as follows:

A. 60,000 DWT collier, NSW/JPN 19 waiting days in NSW loading port. 150,000 DWT collier same delays in NSW to TIN, offload and tranship by 60,000 DWT collier to JPN. Shipping cost compared using calculated TIN service cost of $2.50/tonne.

B. As above, with minimal harbor delays in NSW.

C. As above, except one-half the differential delay days for 60,000 DWT colliers because of the large number of that sized colliers using the available port loaders. Three is likely to be a favorable treatment for the plus 100,000 DWT vessels that utilize the large capacity facilities more effectively. (Table 5.6)

Table 5.6 Shipping Costs Based on Vessel Size
(Dollars Per Ton)

Scenario	A	B	C
60,000 DWT	18.81	12.84	15.84
Less:			
150,000 DWT	9.54	6.06	6.06
60,000 DWT	4.78	4.78	4.78
Tinian Charges	2.50	2.50	2.50
Subtotal	16.82	13.34	13.34
Net savings (cost)	1.99	(0.50)	2.47

The projections above have no reference to the facilities under consideration, the Australian port facilities likely to be used or a Japanese utility receiving port. The following narrative presents a comparison of the alternate shipping schemes as they might be used. The estimating basis is from J. Sasadi (1982). (Table 5.7)

The Japanese power plant used is Matsushima located on the southwestern tip of Kyushu. The plant has an output of 1000 MW and requires 2,080 kt of NSW thermal coal each year. The coal handling facilities include a berth with 14 m draft for 60,000 DWT colliers. Unloading is done by four 700-t/h units to which has been assigned a 1540 net t/h rate. The plant has a 430-kt ground storage. It is the most modern coal-fired unit in Japan and probably represents the standard for future coal-fired plants.

Table 5.7 Characteristics of Queensland (QSLD) and NSW Coal Ports and Their Facilities

Port	# Berths	Vessels k DWT	Ld Rate k t/h	Draft m	Length m
QSLD					
Gladstone	3	55/60	1.6/4.0	11.8	183
				17.2	330
	1	120	4.0	17.2	343
Hay Point	3	150	4.0/6.0	16.8	342
				17.7	365
Brisbane	1	40	1.2	9.1	191
Bowen	1	16	0.7	7.0	167
NSW					
Port Kembla	1	55	2.0	11.0	472
	1	120	5.0	16.3	280
Newcastle	1	55	2.0	11.0	359
	1 (1983)	110	4.0	15.2	540
Sydney	1	55	1.0	11.0	320
	1	35f	1.0f		
Tinian Scheme					
Unloading	1	150	204.0	17.2	308
Loading	1	150	6.4	17.2	308

Analysis of the above port data shows that except for Hay Point, the largest loading facilities are in the 100 to 120,000 DWT class. There is not likely to be more than two 150,000 DWT loaders available for thermal coal loading, and then only to 100,000 DWT plus vessels. The Joint Coal Board (1981) indicates an intent to see that the NSW 100 to 120,000 DWT are used efficiently by larger vessels. They have urged the Japanese to end the stemming of 20 to 30,000 DWT vessels. After a survey the Board concluded that the maximum discharge facilities being constructed by the Japanese cement and power companies are in the 60 to 100,000 DWT range. It appears reasonable to assume that 60,000 DWT vessels will be loaded at the smaller loaders as a policy. The most likely loading rate for 60,000 DWT vessels will be 2000 t/h (1400 net) and for 100,000 DWT plus, 4 to 6000 say 5000 t/h (3500 net).

The approach used in Section 6 is similar to that used by WESTPO (1981) and others to examine the U.S. export port situation. This approach assumes that the Japanese buy coal on a CIF basis. They are noted for resisting CIF contracts and insist on FOBST. The 1981 Coking Coal Manual tabulation shows that in 1979, of the 54 Mt of coal imported, 28 Mt was carried by Japanese Flag vessels, 20 Mt by Foreign Flag Vessels operated by a Japanese shipping company and 6 Mt by Foreign Flag Vessels. It is common practice in Japan that the Japanese Trading Companies assigned to the Group by MITI make the shipping contracts for all coal lifted by the Group. The commission is a big part of their "take" from the Group for their services. This arrangement is an essential part of their raw material negotiating procedure. The two companies that negotiate with the selected mines are able to use a common freight structure.

The larger part of the coal lifted to Japan will be by vessels with Japanese crews. Andrews (1978) states that oriental officered and manner crews cost one-fifth American crews and significantly less than European crews. Cost data for Japanese-crewed vessels is not presently available. The costs adapted from the WESTPO (1981) are used in the following analysis. (Tables 5.8 and 5.9)

Table 5.8 Operating Costs of Various Vessel Sizes

Vessel Size, DWT	60,000	100,000	150,000
At sea, k$	31.6	40.5	47.8
In port, k$	15.9	22.4	25.9

Note: 10% of steaming fuel costs in port.
k$ = $1,000.00

Table 5.9 Comparison of Direct Shipping and the Tinian Alternative

Option		NSW/JPN		NSW/TIN/JPN	
Vessel, DWT		60,000	60,000	100,000	150,000
Voyage		NSW/JPN	TIN/JPN	NSW/TIN	NSW/TIN
RT nm		8536	2344	6192	6192
At Sea Days		23.7	6.5	17.2	17.2
In Port Days					
Loading		1.8	0.7	1.2	1.8
Discharging		1.6	1.6	1.4	2.1
Subtotal		3.4	2.3	2.6	3.9
Add		1.7	1.2	1.3	2.0
Total		5.1	3.5	3.9	5.9
RT Days		28.8	10.0	21.1	23.1
Voyage Cost					
At Sea	k$	748	205	679	822
In Port	k$	81	56	87	159
Total	k$	829	261	784	981
Unit Cost	$/t	13.82	4.35	7.84	6.54
Delivered cost					
Add TIN/JPN	$/t			4.35	4.35
Add TIN/Fee	$/t			2.50	2.50
Total	$/t	13.82		14.69	13.39
Savings (Cost)				(1.07)	0.43
For delay impact add two sea days and two port days					
Cost	$/t	1.57		1.26	0.98
Total	$/t	15.39		15.95	14.37
Savings (Cost)				(0.56)	1.02

Note: k$ = $1,000.00

The cost data developed in the Transshipment section with the input and the alternate costs in the above table indicate that the utilization of the Tinian Coal Center's facilities will include a modest savings if the NSW leg is done with 150,000 DWT colliers. If this is the case, then the important intangible benefits will accrue to the users without cost. Intangible benefits convert to tangible savings when the coal delivery system is stressed as during 1980. While the loss of business caused by the industrial strife may lead Australian labor to more temperate ways, it is too much to expect that there will not be further supply disruptions in Australia or in North America.

The Tinian Coal Center as presently conceived would have a conservative unloader capacity adequate to service eight units the size of Matsushima. Between seven and eight 150,000 DWT colliers would be required. At 4.0 Mt the ground storage would be 500 kt per unit which, added to the 400 kt on-site storage, would be about a minimum emergency stock for a 100% burn for 90 days. The Tinian ground storage can be increased and the handling equipment expanded with a modest additional capital expenditure.

ADDITIONAL BENEFITS TO THE AREA

Low cost coal for energy or industrial use would become available in the area. This could enhance the construction of a coal-fired plant on Tinian with sufficient capacity to service the coal center, the military complex and Saipan via cable. Low cost coal for a Guam coal-fired plant and other island plants would substantially reduce the energy costs.

The encouragement of service industries associated with relatively heavy ship traffic would provide opportunities for local employment and the development of new skills. The towns of Gladstone and Hay Point, Queensland, provide examples of this potential economic benefit.

6

Transshipment

TRANSSHIPMENT

SOURCES OF USER SAVINGS

The purpose of this task is to determine if a full scale economic feasibility study of the proposed coal transshipment facility to be located in the Northern Marianas is warranted. To provide a background for the assessment the next section takes a look at the current and the projected pattern of international trade in coal in the Pacific area.

According to a generally accepted criterion, a facility is considered feasible if expected benefits generated by the facility exceed the associated costs. However, while the benefit/cost analysis takes into account all benefits and all costs to whomever they may accrue, there will be no demand for services of the transshipment facility unless there are private benefits, i.e., net savings that accrue to the users of the facility. Thus, rough estimates of probable savings are found in this section.

The net savings estimated provide the upper limit to charges for use of the facility. This section investigates the financial viability of the transshipment facility if revenue stream is limited to net savings. This section also provides a brief summary and conclusions.

If there is to be a demand for services of the transshipment facility, there have to be net savings that would accrue to users of the facility. This section examines two possible sources of these savings--economies of scale associated with large size vessels and assurance of uninterrupted supply of coal at lower cost.

SAVINGS FROM UTILIZATION OF LARGE SIZE SHIPS

In most cases, the ability to realize economies associated with large size vessels is the main source of benefits to be derived from the transshipment facility. For example, the expected savings due to utilization of 500,000 DWT tankers from Persian Gulf ports to the transshipment facility versus use of 120,000 DTW or 250,000 tankers from Persian Gulf to destination ports was the basis of the proposal for development of a transshipment and storage port at Palau. (Panero, 1975)

Although the proposal did not estimate the net savings attributable to the transshipment facility, the data supplied allow a rough estimate to be made. The planned throughput of the facility was 50 million tons of crude per year, and the following freight costs for different tanker sizes were reported:

Tanker Size (DWT)	Persian Gulf-Japan ($US/kiloliter*)
36,000	14.61
89,500	10.24
120,000	9.73
250,000	6.93
500,000	5.00 (projected)

*one kl = 1000 litres = 0.85 metric ton (for Iranian heavy crude, as an example)

Thus, a very rough estimate of gross savings is equal to the difference in freight costs of transporting 50 million tons of crude in 120,000 DWT or 250,000 DWT and in 500,000 DWT tankers. These savings are $278.5 million or $113.5 million, respectively, or the equivalent of $5.57 or $2.27 per ton. The charge for use of transshipment facility was estimated at $1.15 per ton. Thus, the net savings to the users would total $221 million or $56 million, depending on whether the direct shipment would be made using 120,000 DWT or 250,000 DWT tankers.

These estimates are probably biased upward because they do not include the higher cost of transporting crude from the transshipment port to the port of ultimate destination. The upward bias may be somewhat offset by somewhat lower freight costs from the Persian Gulf to Palau using 500,000 DWT tankers because of a shorter distance.

The economy of ship size is also a possible source of savings in case of a coal transshipment facility. The sizes of coal transport ships have been increasing. The distribution of vessels by size employed in the coal trade as well as the distribution of new orders among size classes indicates a clear trend toward use of larger ships (Table 6.1). This trend is expected to continue in the future (Table 6.2).

The evidence suggests that although there has been a significant increase in sizes of coal transport ships, this trend has a way to go before economies of large size ships are fully realized. This, in turn, is due to a large extent to draft limits at the export and/or import ports and the size constraints imposed by the Panama Canal. The situation, however, is in the process of being remedied. Ongoing improvement projects will allow major loading ports in the future to handle ships up to 170,000 DWT (Table 6.3). Similar improvements are being made at ports unloading metallurgical coal. In Japan, for example, by 1983/4 these ports will be able to handle ships up to 150,000 to 300,000 DWT. However, ports unloading thermal coal for power stations in Japan, South Korea, Taiwan and Hong Kong will be limited to 100,000 to 130,000 DWT vessels. According to another source, even by 1980 steam coal receiving ports in the Pacific Rim Countries accounting for 42% of total capacity will not be able to handle vessels larger than 60,000 DWT (Table 6.4).

In this scenario there is a possible role for a transshipment facility. One option is to ship coal to the transshipment port using large (e.g., 150,000 DWT or even 170,000 DWT) vessels and to distribute it to destination ports using smaller vessels that receiving ports can accommodate. Another option is to ship directly to destination ports using the maximum size vessels the receiving ports can handle (e.g., 60,000 DWT). It is possible that the first option could generate sufficient savings due to use of large vessels to more than offset extra unloading and loading costs at the transshipment facility.

The available data on daily vessel costs by size of vessel in 1980, shown in Table 6.5, provide a basis for estimating the cost of two options discussed above. In order to extrapolate to the in-between

Table 6.1 Comparison of Size Distribution of New Building Orders For Bulkers With Vessels Already Employed In The Coal Trade

Size Class (DWT x 1000)	% of World Dry Bulk and Combination Carrier Fleet on Order (DWT)	Vessels Employed in the Coal Trade (% of Cargo Carried)				
		1965	1970	1975	1976	1977
Less than 25	5.7%	63%	40%	29%	25%	23%
25 - 40	23.1	23	21	12	12	10
40 - 60	10.6	11	21	24	24	21
60 - 100	39.5	3	12	25	25	29
above 100	21.1	--	--	10	14	19

Sources: Marine Engineering Log 1980 Yearbook. Simmons-Boardman Publishing Corp., 1980.

Bulk Systems International, July 1979.

Table 6.2 Projected Distribution of Steam Coal Shipments in Ton-Miles, By Ship Size (percent)

Year	Ship Size (thousand DWT)							
	20	20-35	35-50	50-80	80-100	100-150	150+	Total
1980	10	13	22	43	5	7	-	100
1985	6	7	19	39	4	17	8	100
1990	4	6	13	27	6	27	17	100
1995	3	5	10	24	6	30	22	100
2000	2	4	8	21	7	33	25	100

Source: H. P. Drewery Shipping Consultants, Ltd. Changing Ship Type/Size Preferences in the Dry Bulk Market. (London, England: HPD Publications, 1980)

Table 6.3 Major Port Loading Facilities

Country	Port	1983/84 Maximum ship size 10^3 DWT	1983/84 Throughput capacity mtpa	1987/90 Maximum ship size 10^3 DWT	1987/90 Throughput capacity mtpa
Australia	Abbott Point	150	4	150	10
	Hay Point	150	35	170	50
	Gladstone	120	21	120	30
	Newcastle	120	25	170	40
	Port Kembla	150*	14	170	30
Canada	Roberts Bank	150	24	150	24
	Prince Rupert	-	150	10	
South Africa	Richards Bay	170	35	170	65
United States	East Coast	120*	85	150*	110
	Gulf	60	30	150*	40
	West Coast	60	5	150*	20
South America	Colombia	-	-	120-150	15

*Partly laden. Maximum ship sizes and port capacities indicative only.

Source: Shell Coal International

Table 6.4 1990 Receiving Port Capacity For Pacific Rim Steam Coal Imports

By Vessel Size Accommodated

(MTPY; % of Total Capacity)

Vessel Size	Japan		Taiwan		Korea		Total	
100,000+ DWT	23.8*	39%	18.4	69%	5.2	31%	47.4	45%
60,000+ to 100,000 DWT	11.9	19%	-	-	4.6	27%	16.5	16%
Panamax or smaller (to 60,000 DWT)	25.8	42%	8.1	31%	7.2	42%	41.1	39%
	61.5	100%	26.5	100%	17.0	100%	105.0	100%

*Includes 7.0 million tons capacity planned for Sakito Coal Center. Construction of this facility by 1990 is now considered uncertain.

sizes, the daily vessel costs per day at sea and in port were regressed on size of the vessel. The regression equations obtained are as follows:

$$\text{Log CS} = 8.5978 + 0.3948 \text{ Log DWT} \qquad R2 = 0.9875$$

$$\text{Log CP} = 8.1171 + 0.4143 \text{ Log DWT} \qquad R2 = 0.9808$$

where CS = daily costs at sea; CP = daily costs in port; and DWT = vessel size measured in 1,000 dead weight tons. These equations were used, in turn, to estimate daily vessel costs for a range of vessel sizes shown in Table 6.6. In addition, the following set of assumptions was adopted:

1. Distances

   NSW (Newcastle, N.S.W.) - JPN (Japan, Yokohama): 4268 nautical miles;
   NSW - SPN (Saipan): 3096 nautical miles;
   SPN - JPN : 1172 nautical miles;

2. Vessel's speed

   15 knots;

3. Actual tonnage of coal loaded and discharged per voyage

   97% of vessel's dead weight tons;

4. Nominal loading rate

   7,000 tons per hour (both NSW and Saipan);

5. Effective loading rate

   70% of nominal loading rate;

6. Loading and discharging working time

   24 hours per day;

7. Vessel's waiting in port

   19 days in NSW, no waiting time in JPN or SPN;

Table 6.5 Daily Vessel Costs in U.S. Dollars per Day in 1980

	Vessel Size			
	40 (MDWT)	65 (MDWT)	120 (MDWT)	175 (MDWT)
ownership cost[a]	$ 8597	$ 9826	$ 13560	$ 17196
daily operating cost including overhead[b]	4526	5314	5820	8143
fuel cost/day, at sea	10038	13608	15097	17247
in port	2658	3488	3877	4267
Total cost/day-at sea	23161	28748	34477	42586
in port	15781	18628	23257	29606

[a]Includes 10 percent return on investment, 80% of purchase price financed at 8% for 8½ years, 15 year life and zero salvage value.

[b]Includes manning, stores, repairs and maintenance, insurance and administration.

Source: H. P. Drewery Shipping Consultants, Ocean Shipping of Coal, Survey No. 24, October 1981, pp. 92, 94 and 97.

Table 6.6 Daily Vessel Costs by Size of Vessel in 1980 (in U.S. dollars)

	60,000 DWT	100,000 DWT	130,000 DWT	150,000 DWT	170,000 DWT
At Sea	27,284	33,379	37,022	39,173	41,157
In Port	18,275	22,582	25,175	26,713	28,135

8. Nominal discharging rate

4,000 tons per hour (two unloaders working at the same time with 2,000 tons capacity each); same for Japan and Saipan;

9. Effective discharging rate

60% of nominal discharging rate;

10. Extra days in port for contingencies and vessel's operations

Two days in each loading and discharging ports respectively;

11. Ballast voyages

Vessels return with ballast.

Given these assumptions and the daily vessel cost estimates, the cost of transporting coal per ton can be estimated for various vessel sizes and for three routes involved in two options being evaluated. Such a set of cost estimates is reported in Table 6.7. According to these estimates, the transshipment option would result in lower cost per ton if the option of shipping direct is limited to use of 60,000 DWT vessels as long as shipment of coal from NSW to Saipan is in 100,000 DWT or larger vessels (since $4.78 + 11.86 = 18.81).

However, this conclusion rests heavily on the assumed waiting time at the NSW ports which on the average in 1980-81 varied from 16 to 21 days (Waters II, 1982), the situation which was likely to be remedied in the future. Therefore, the cost estimates were revised, assuming no waiting time at the NSW ports. The new set of cost estimates is shown in Table 6.8. According to these estimates, transshipment costs are still lower than direct shipment using 60,000 DWT vessels, but the differences are smaller. In fact, unless 150,000 or 170,000 DWT vessels are used to transport coal from NSW to Saipan, the cost savings are not likely to be large enough to offset extra loading and unloading at the transshipment facility.

These estimates suggest possible gross savings in the $2.00 to $3.00 per ton range. Japan's imports of steam coal in 1990 have been estimated at 44 million tons. As cited above, 42% of this coal will be

Table 6.7 Estimated Cost of Transporting Coal by Size of Vessel, 1980
(U.S. $ per ton)

Route	60,000 DWT	100,000 DWT	130,000 DWT	150,000 DWT	170,000 DWT
NSW - JPN	18.81	14.09	12.20	11.29	10.57
NSW - SPN	15.76	11.86	10.29	9.54	8.94
SPN - JPN	4.78	3.75	3.36	3.18	3.03

Table 6.8 Revised Estimated Cost of Transporting Coal by Size of Vessel, 1980 (U.S. $ per ton)

Route	60,000 DWT	100,000 DWT	130,000 DWT	150,000 DWT	170,000 DWT
NSW - JPN	12.84	9.67	8.41	7.81	7.33
NSW - SPN	9.79	7.43	6.50	6.06	5.70
SPN - JPN	4.78	3.75	3.36	3.18	3.03

destined to ports unable to handle vessels larger than 60,000 DWT (Table 6.4). Suppose that transshipment facility is utilized for this coal, the gross savings would total $37 to $55 million per year (18.48) mil. tons x $2.00 or $3.00).

These gross savings limit the charges for use of facility to less than $2-to-$3 per ton. The next question is whether the transshipment facility, with throughput of 18.5 million per year and generating revenues of some $35 to 55 million per year would be financially feasible, i.e., would these revenues more than cover the costs. The remainder of this section discusses another possible source of benefits--stockpiling of coal in order to insure against fluctuations in supply.

STOCKPILING AS A MEANS OF PREVENTING SUPPLY INTERRUPTION

It has been asserted on numerous occasions that the supply of coal from Australia is unreliable. The following statement is rather typical:

> "...Reliability of supply has been a concern of importers of Australian coal since labor problems have been endemic. Water-side workers have been associated with many export bottlenecks in the past, with bans and limitations on exports being common issues. However, labor problems have also extended to the mines, railroads and loading facilities." (Borg, 1983)

In spite of the frequency of these assertions, there does not appear to be any data on frequency and duration of these supply interruptions. The following two statements come closest to quantitative estimates:

> "Newcastle, with probably 18 million metric tons of capacity, is likely to be able to move only 13 million tons in 1982 due to inter-union manning disputes, etc." (Lynch, 1981)

and

> "A report by New South Wales Joint Coal Board states that production of raw coal in 1980 in NSW was 50,720,200 tons compared

with 50,887,500 tons in 1979. Production during the first half of 1980 was seriously disrupted by industrial disputes at the mines. These disputes particularly affected underground production which fell some 3.2% over the year to 36,766,000 tons. After May 1980, production improved and during the second half of the year was equal to an annual rate of 56,000,000 tons." (World Coal, 1981)

The above, admittedly fragmentary evidence, suggests that the supply interruptions may indeed be sufficiently frequent and of sufficiently long duration to impose significant costs on the Japanese industry. If that is indeed the case, there are two possible solutions--diversification of purchases among various sources of supply and/or stockpiling.

As it was shown above, Japanese do purchase thermal coal from several suppliers. Indeed, according to one study, the Japanese are believed to be willing to pay $6 to $7 more per ton for American coal than for coal from other countries because of the stable U.S. coal supply (Page and Farragut, 1981). It is not clear, however, whether the observed diversification of purchases is motivated by desire to avoid supply interruptions or merely because the lowest cost producer (i.e., Australia) is unable to satisfy their total demand.

The monthly variations of Japanese coal imports from Australia and from other sources may provide a clue to the extent that purchases from other sources are being used to offset reductions in supply from Australia. Two indices of Japanese indices by source for 1981 are shown in Figure 6.1 and Table 6.10. If coal purchases from other sources are used to offset shortages of Australian coal, the two indices should move in the opposite directions.

There is no evidence that this has happened during the first half of 1981, but the indices appear to move in the opposite direction during some months in the second half. However, the data on Australian steam coal exports to Japan in 1980 and 1981, shown in Figure 6.2 and Table 6.11, exhibit a similar pattern suggesting that seasonal factors may have been responsible for the observed differences. The most notable exception is the sharp drop in exports in June 1980, which was probably caused by a labor strike or similar supply interruption. The indices of

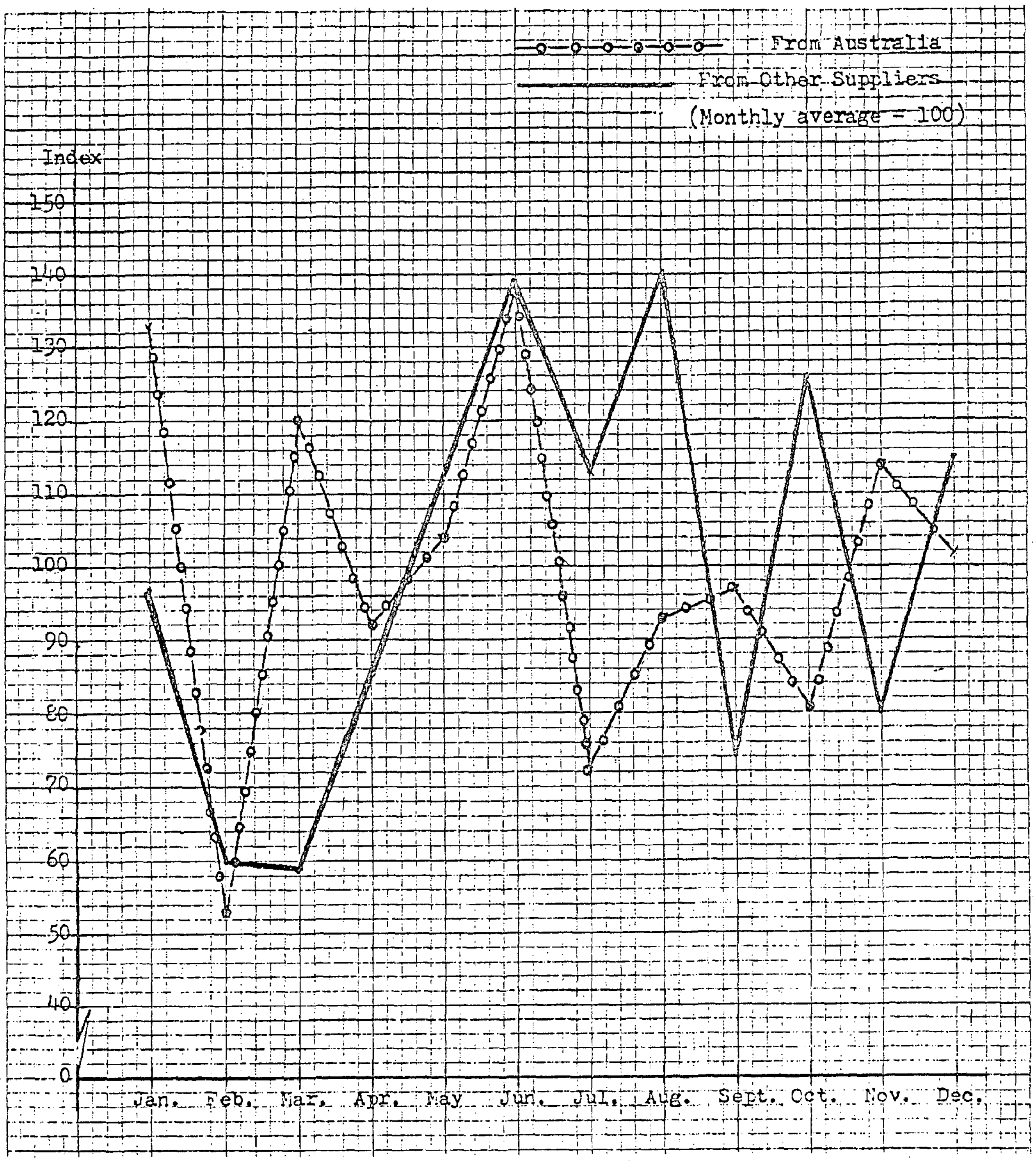


Figure 6.1 Indices of Japan's Thermal Coal Imports by Source, 1981

Table 6.9 Japan's Thermal Coal Imports by Source, 1981

Month	From Australia Tons[a]	From Australia Index[b]	From Other Suppliers Tons[a]	From Other Suppliers Index[b]
January	632	133	481	97
February	251	53	300	60
March	567	120	292	59
April	435	92	424	85
May	490	104	557	112
June	654	138	689	139
July	347	73	563	113
August	438	93	698	140
September	458	97	369	74
October	384	81	625	126
November	537	114	396	80
December	483	102	571	115
Total	5676		5965	
Average	473	100	497	100

[a]Thousand Metric Tons - delivered.

[b]Monthly Average = 100.

Source: Merrill Lynch, Pierce, Fenner & Smith (1982)

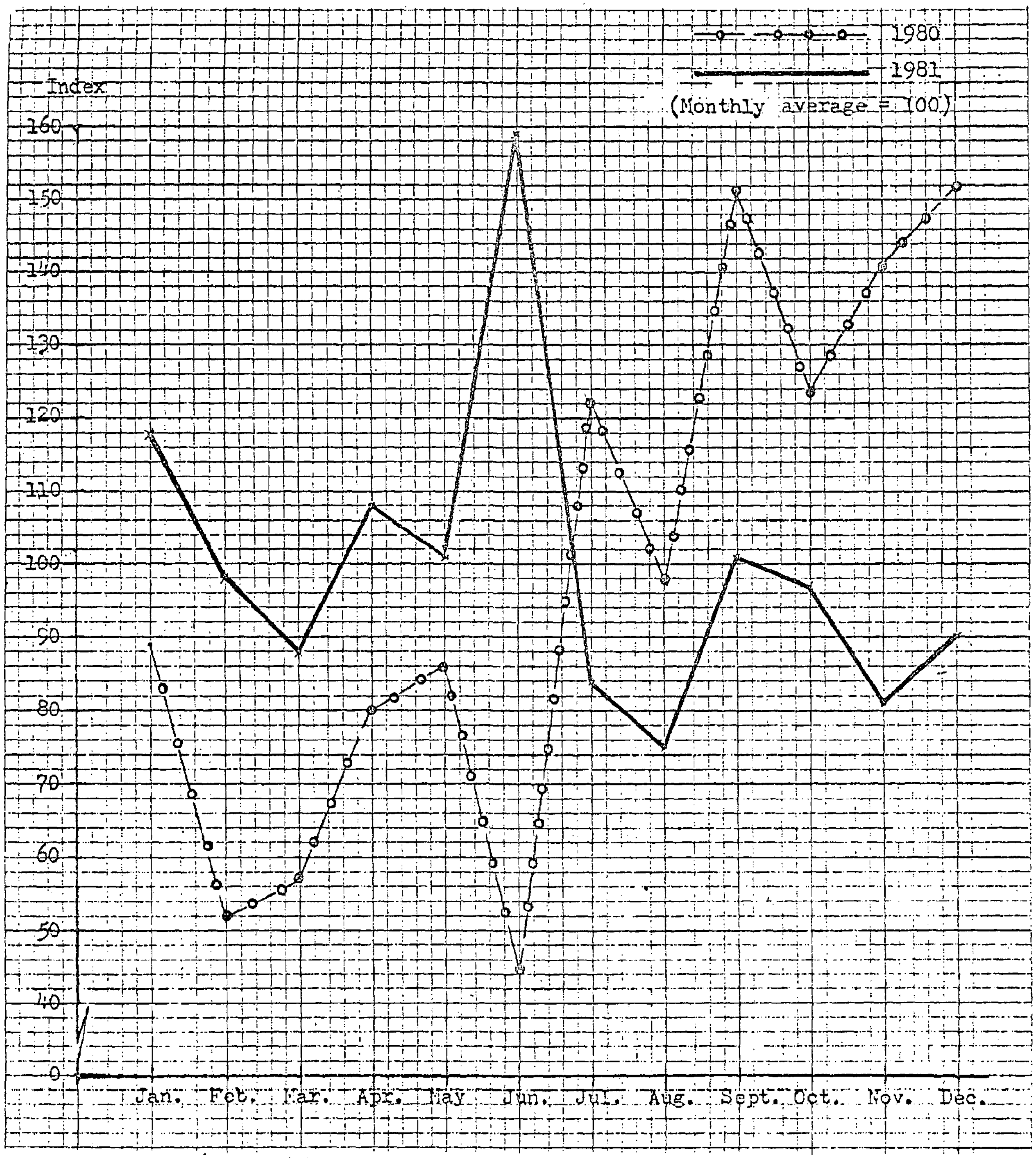


Figure 6.2 Indices of Australian Non-Coking Coal Exports to Japan

Table 6.10 Australian Non-Coking Coal Exports to Japan

Month	1980 Tons[a]	1980 Index[b]	1981 Tons[a]	1981 Index[c]
January	268	89	558	118
February	158	52	460	98
March	173	57	416	88
April	241	80	507	108
May	260	86	477	101
June	137	45	747	159
July	367	122	396	84
August	296	98	351	75
September	456	151	477	101
October	375	124	459	97
November	427	141	383	81
December	460	152	424	90
Total	3618		5655	
Average	302	100	471	100

[a]Thousand Metric Tons - exported.

[b]1980 Monthly Average = 100.

[c]1981 Monthly Average = 100.

Source: Merrill, Lynch, Pierce, Fenner & Smith (1982) total Australian steam coal exports, shown in Figure 6.3 and Table 6.11, also suggest a strike in May-June 1980 or 1980 and additional supply interruptions during August-November 1981. Unfortunately, the 1980 and the 1981 shipment patterns may have been affected by events outside Australia. At the end of 1980 shipments may have been motivated by the anxiety over the expected coal miners' strike in the U.S., and in 1981 actually affected by this strike.

The evaluation of the second solution, i.e., stockpiling, is also hampered by the same data unavailability. We know, however, that it has been considered. In fact, according to Melvin Shore:

> "...There is an example, one case that I am aware of, where because of their own recognition of their labor problems, the Australians have actually been moved to stockpile some commodity on the West Coast of the United States in order to reach the Japanese market." (Statement of Melvin Shore, Port Director, Port of Sacramento, made during discussions following presentation of his paper (Shore, 1979).)

Thus, stockpiling at the transshipment facility, in order to avoid supply interruptions, may be another source of benefits.

In order to estimate these benefits, it is necessary to have information on the frequency and duration of supply interruptons since they, together with the interest rate, would determine the optimum volume of the stockpile. Furthermore, it is possible to stockpile at destination or at the transshipment facility. The choice of location would depend on the difference in storage costs. It is reasonable to assume that these costs would be lower at the transshipment facility than in Japan. Thus, there are potential benefits in stockpiling at the transshipment facility unless coal in Japan could be stockpiled at the coal using facilities eliminating extraloading and unloading. This, however, is very unlikely.

Although these benefits could not be estimated in this preliminary assessment, there are likely to be net savings generated from stockpiling coal at the transshipment facility. These benefits, therefore, should be estimated in the full scale economic feasibility study. Furthermore,

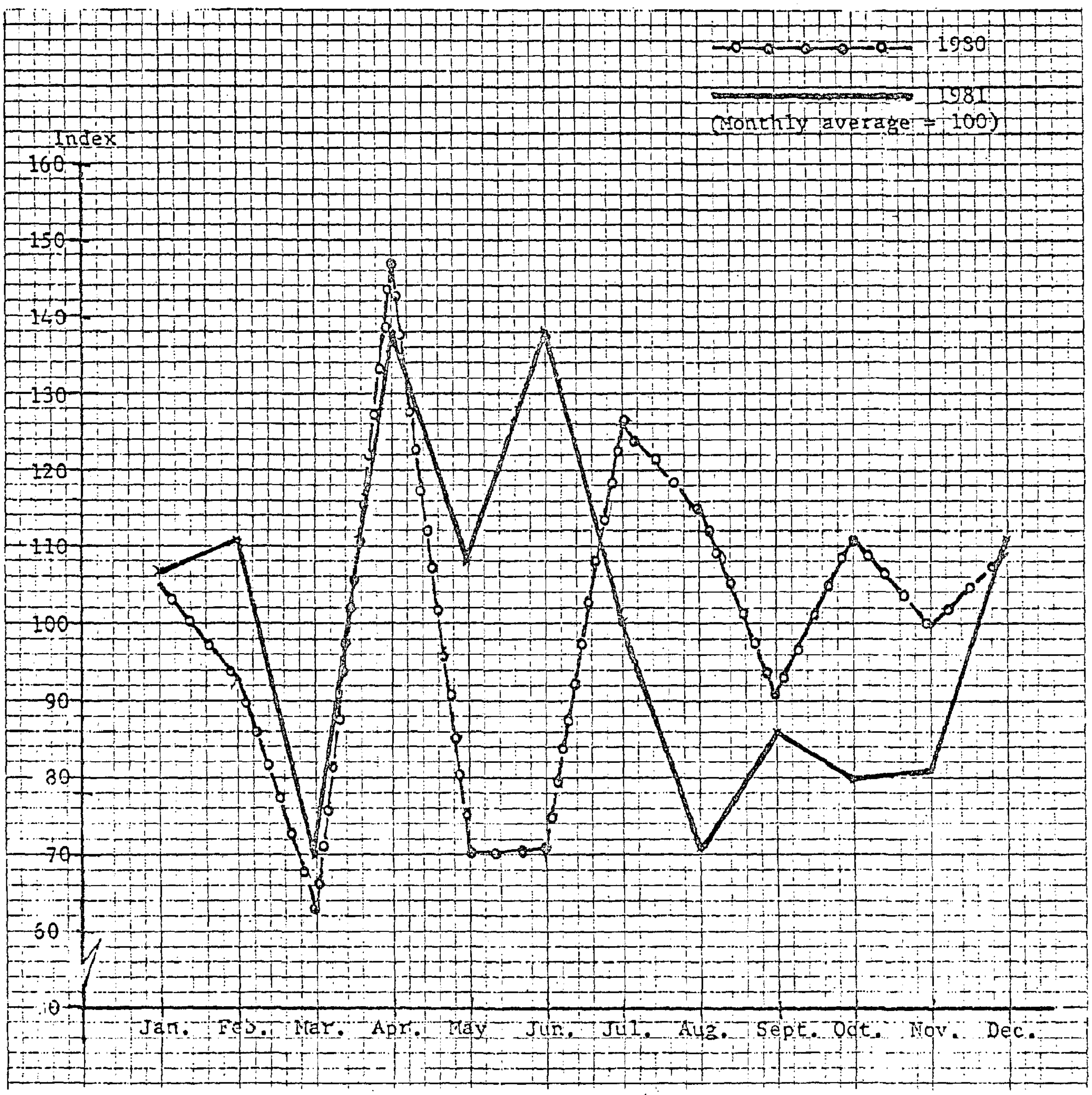


Figure 6.3 Indices of Total Australian Non-Coking Coal Exports

Table 6.11 Total Australian Non-coking Coal Exports

Month	1980 Tons[a]	1980 Index[b]	1981 Tons[a]	1981 Index[c]
January	785	105	938	107
February	692	93	947	111
March	469	63	615	70
April	1097	147	1216	138
May	528	70	946	108
June	533	71	1214	138
July	939	126	831	100
August	856	115	625	71
September	682	91	756	86
October	826	111	703	80
November	750	100	713	81
December	812	109	978	111
Total	8969		10559	
Average	747		880	

[a]Thousand Metric Tons - exported.

[b]1980 Monthly Average = 100.

[c]1981 Monthly Average = 100.

Source: Merrill Lynch, Pierce, Fenner & Smith (1982)

both stockpiling and diversification of purchases should be investigated in greater detail. It is likely that a combination of stockpiling and diversification among sources of supply is the optimum strategy to assure an uninterrupted flow of coal to Japan.

COAL TRADE IN THE PACIFIC REGION

Coal deposits are much more widely distributed than oil. Thus, practically all industrialized countries can supply at least part of their demands by domestic production. A significant proportion of coal also moves relatively short distances. Nevertheless, the world seaborne trade in coal accounts for a significant proportion of total world trade, having increased dramatically since the oil crises of 1973-74. The volume and pattern of the trade in 1980 is shown in Table 6.12. According to OECD (1982), 1981 saw another 4.2% increase over the 1980 volume and totaled some 196 million tons.

In the Pacific Basin area Japan, South Korea and Taiwan were the principal importers and Australia, the United States, Canada and South Africa were the principal exporters. The volume and pattern of trade in the Pacific region are shown in Table 6.13.

Japan is the largest importer of coal. In 1981, Japan's imports of coal accounted for about 40% of the world's coal trade and for almost 88% of the Pacific region's coal receipts.

Japanese coal imports by source are shown in Table 6.14. Currently, most of the coal comes from Australia, followed by the United States, Canada and South Africa. No drastic changes in the share of coal imports by source is expected in the future.

Currently, world trade is dominated by trade in metallurgical coal. In 1981, metallurgical coal totaled some 117 million tons and accounted for about 60% of the total world's seaborne trade of coal. However, it is generally expected that the future coal trade will increasingly consist of steaming of thermal coal used for thermal generation of electricity as well as in some industrial processes (e.g., cement, paper, etc.).

Table 6.12 World Seaborne Coal Trade in 1980

in thousand metric tons

FROM \ TO	UK/ CONTINENT	MEDITER-RANEAN	OTHER EUROPE	SOUTH AMERICA	JAPAN	OTHERS	WORLD 1980	WORLD 1979	WORLD 1978
Eastern Europe	8,160	3,229	8,995	979	724	244	22,331	29,256	28,401
Other Europe	3,344	2,597	1,852	29	-	182	8,004	6,759	7,795
North America	22,175	8,686	8,633	5,766	31,378	4,988	81,626	56,045	36,381
Australia	6,504	1,174	1,333	52	29,327	4,754	43,144	40,790	35,283
South Africa	13,364	3,058	4,206	-	3,289	3,351	27,268	20,703	14,093
Others	352	8	94	-	4,390	1,228	6,072	5,867	4,573
World 1980	53,899	18,752	25,113	6,826	69,108	14,747	118,445		
World 1979	44,195	17,730	20,398	5,983	59,112	12,002		159,420	
World 1978	31,050	13,290	18,012	4,473	51,036	8,665			126,526

NOTE: The term "Coal" comprises anthracite and bituminous coal. Export statistics are used whenever possible. Exports from the United States to Canada are excluded. Exports from Siberia to Japan are included under Eastern Europe - Japan. Coal transportation between most continental countries as well as between East European countries is considered as overland transportation.

Source:OECD (1982)

Table 6.13 Coal Trade in the Pacific Region

in thousand metric tons

Importers / Exporters	Australia		U. S. A.		Canada		S. Africa		Others	Total imports	
	1980	1981	1980	1981	1980	1981	1980	1981	1980	1980	%
Japan	30,128	35,015	20,928	23,444	10,450	10,852	3,288	-	1,752	66,519	87.8
South Korea	2,777	3,489	1,251	1,498	1,131	1,897	-	-	-	4,659	6.2
Taiwan	826	530	400	1,612	-	-	1,626	708	-	2,825	3,8
Others	976	2,601	304	1,577	415	517	-	-	-	1,695	2.2
Total Exports	34,207	41,635	22,883	28,131	11,996	13,266	4,914	-	1,752	75,725	100.0%
(%)	45.2	-	30.2	-	15.8	-	6.5	-	2.3	100.0%	

Source: Compiled from Merrill Lynch, Pierce, Fenner & Smith (1982)

Table 6.14 Japanese Coal Sources
(million metric tons)

Source / Year	1981 Amount	1981 %	1985E Amount	1985E %	1990E Amount	1990E %
Australia	34.8	44.6	45	46.4	55	47.0-45.5
United States	23.7	30.4	24	24.7	25	21.4-20.7
Canada	10.7	13.7	16	16.5	20	17.1-16.5
South Africa	4.2	5.4	6	6.2	8	6.8-6.6
China (R.R.)	2.4	3.1	4	4.1	6-8	5.1-6.6
U.S.S.R.	1.4	1.8	2	2.0	2-4	1.7-3.3
Other	.8	1.0	1	1.0	1	0.9-0.8
Total	78.0	100.0%	97	100.0%	117-121	100.0%

Source: Merrill Lynch, Pierce, Fenner & Smith (1982)

According to available forecasts of overall steam coal trade and oceanborne steam coal trade, shown in Tables 6.15 and 6.16, the volume of coal is expected to quadruple from the volume in 1981. According to another forecast, shown in Table 6.17, the imports of Pacific Rim countries are expected to increase at an even faster rate.

Japan's imports of steam coal increased dramatically in recent years and this trend is expected to continue into the future. The latest available forecast of steam imports by the ultimate user and the long-term forecasts of energy supply are shown in Tables 6.18 and 6.19.

Distribution of Japan's imports of steam coal by source are shown in Table 6.20. Drastic changes in this distribution are expected in the future. Australia is expected to supply about half of Japan's imports.

This short overview of the current and projected pattern of coal trade in the Pacific region suggests that the potential feasibility of the coal transshipment facility is tied closely to Japan's imports and, more specifically, to imports of thermal coal. This allows narrowing the focus of the task to this specific aspect. Consequently, the following section looks at the possible gains to users of the transshipment facility. Since coal contracts commonly specify FOB port of origin these gains would accrue to the importers, i.e., the Japanese.

Table 6.15 Steam-coal Trade Forecasts (MST[a])

Market	U.S.	Australia	South Africa	Other[b]	Total
Western Europe					
1985	28	17	38	19	102
1990	48	28	61	39	176
1995	63	63	80	51	257
Japan and Pacific Rim					
1985	8	28	4	18	58
1990	23	46	12	36	117
1993	48	77	22	53	200
Canada (Eastern)					
1985	12	-	-	-	12
1990	12	-	-	-	12
1995	12	-	-	-	12
Others					
1985	2	3	2	-	7
1990	5	6	2	-	13
1995	5	7	8	-	20
Total[c]					
1985	50	48	44	37	179
1990	88	80	75	75	318
1995	128	147	110	104	489

[a]Millions of "standard" short tons (24 x 10^{12} Btu).

[b]Western Canada, Colombia, China, USSR, and Poland.

[c]Excludes Eastern Europe.

Source: Borg, I. Y. (1981), p. 6.

Table 6.16 Forecasts of Oceanborne Steam-Coal Trade (million tons)

On routes from:	1980	1985	1990
Poland	16.0	21.0	23.0
South Africa	18.7	36.5	54.2
Australia	8.5	28.6	66.9
Other origins	7.9	23.7	70.9
Total	51.1	110.4	215.0

Source: Doerell, Peter E. (1981) quoted from H.P. Drewery (Shipping Consultants) Limited, The Growth of Steam Coal Trade.

Table 6.17 Demand for Imported Steam Coal - Far East (MMT[a])

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Japan	9.4	15.5	18.3	23.4	27.5	34.6	37.0	50.2	57.4	62.7
Taiwan	-	0.6	1.9	2.7	3.5	6.0	10.0	12.2	13.8	15.8
Korea	0.5	2.7	5.6	7.6	8.7	10.0	12.0	13.2	14.3	15.8
Hong Kong	-	1.3	2.8	3.9	4.7	5.2	6.4	8.2	8.2	8.2
Singapore	-	-	-	-	-	-	-	-	1.6	1.6
Others[b]	-	-	-	-	-	-	-	2.0	2.0	2.0
Total	9.9	20.1	28.6	37.6	44.4	55.8	65.4	85.8	97.3	106.1

[a]Million metric tons.

[b]Others, like the Philippines.

Source: Borg, I. Y. (1981), p. 6.

Table 6.18 Japanese Steam Coal Forecast

Industry	1980	1981	1982E	1985E	1990E
Electric Utility	9.8	12.3	13.4	20.0	33.0
Cement	7.1	9.1	10.0	12.5	14.0
Paper, etc.	4.2	3.5	4.6	6.5	9.0
Total	21.1	24.9	28.0	39.0	56.0

Source: Merrill Lynch, Pierce, Fenner & Smith (1982)

Table 6.19 Japanese Long Term Energy Forecast

Energy Supply	1977	1980	1985 E Forecast Date Aug. 28, 1979	1990E Forecast Date 8/28/79	1990E Forecast Date 4/82
Coal Mil. Tons					
Domestic	19.72	18.10	20.00	20.00	18 - 20.00
Imported	58.29	74.30	101.00	143.50	134.00
Coking	57.34	64.52	79.00	90.00	80.00
Thermal	0.95	7.10	22.00	53.50	54.00
Nuclear Mil. KW	8.00	15.70	30.00	53.00	46.00
Hydro Mil. KW	26.15	29.80	41.50	53.00	46.55
Imported Oil Ml Kl	307.00	285.00	366.00	366.00	290.00
LPG Mil. Tons	7.39	14.00	20.00	26.00	24.00
LNG Mil. Tons	8.39	25.90	29.00	45.00	68.00
Total Mil. Kl.	412.00	429.00	582.00	716.00	590.00

Source: Merrill Lynch, Pierce, Fenner & Smith (1982)

Table 6.20 Japan's Import of Thermal Coal by Source

in thousand metric tons delivered

Source	1979 Amount	1979 (%)	1980 Amount	1980 (%)	1981 Amount	1981 (%)
Australia	1,000.48	71.1	3,529.37	67.6	5,676.11	48.8
U. S.	0.12	0.0	389.09	5.5	2,118.90	18.2
Canada	12.60	0.9	328.28	6.3	1,139.70	9.8
S. Africa	21.28	1.5	238.09	4.6	1,262.89	10.8
U.S.S.R.	117.06	8.3	222.61	4.3	255.20	2.2
P.R.O.C.	256.28	18.2	612.83	11.7	1,188.16	10.2
Total	1,407.82	100.0	5,220.27	100.0	11,640.96	100.0

Source: Compiled from Merrill Lynch, Pierce, Fenner & Smith (1982)

7

Coal Centers

COAL CENTERS

The Commonwealth of the Northern Marianas lies along the main coal shipping routes between the Australian coal fields and their Japanese customers. The Commonwealth Government has requested this study to determine in a preliminary manner the feasibility of a coal transshipping facility located in the CNMI.

This study uses the public sector knowledge of the international coal trade practices as input. From this input the most useful type of facility for the CNMI is selected. Potential users have been studied and the most likely nominated. The tangible and intangible benefits to the user are analyzed. Capital and operating data from technical articles on recent installations have been used to estimate the order of magnitude economics for a CNMI-based facility. The environmental exposures are discussed.

FACILITY SCHEMES

The three main schemes for transshipment facilities for an island site are:

Scheme 1): Coal transfer vessel to vessel; normally be controlled by harbor regulations and obtain port charges. The revenues derived would be unlikely to justify the cost of dredging required for large vessels. The scheme would be used for small vessels or barges on a casual basis.

Scheme 2): A shore-based transfer operation without ground storage; would require extensive harbor dredging for mooring and a turning basin, marine construction and bulk material handling equipment would entail a large investment. This scheme requires the least land area and minimum environmental exposure. The scheme is unlikely to be implemented because of its low cost benefits to a user.

Scheme 3): A coal transferring facility with large ground storage, high capacity bulk material handling equipment with blending capability, and a harbor draft for 150,000 DWT bulk carriers. This facility would be unique and offer the greatest tangible and intangible benefits to the user and revenue to the CNMI. Depending on the layout, the site would occupy from 200 to 250 ha (500 to 700 acres). That portion of the Island of Tinian adjacent to the harbor of San Jose appears to have excellent potential for a site. A transshipping point with these capabilities is properly called a "Coal Transshipment Center" (CTC).

The Coal Center scheme is only practical when the land area with the harbor potential lies on existing shipping routes. Tinian has the area adjacent to a harbor site, far much larger ground storage than most terminals. Tinian is located about three-quarters of the distance from New South Wales (NSW) coal ports to Yokohama, Japan (JPN): NSW-Tinian-JPN is 4268 nm, NSW-Tinian is 3096 nm and Tinian-JPN is 1172 nm.

The CNMI would derive the greatest economic benefits, both direct and indirect, from a CTC. The environmental exposures would be significant but can be mitigated by existing means in use, which can be inspected at major coal ports in Australia.

THE COAL CENTER

Tinian is a low, flat island lying three miles south of Saipan. It is 12.6 miles long, 6.1 miles wide and has a land area of 42 square miles. The highest elevation is 584 feet. Geologically it consists of a raised limestone reef.

The U.S. Department of Defense, on January 6, 1983, signed a $33 million land lease agreement with CNMI for defense facilities use on the northern part of the island. The Coal Center proposed herein would be located on the southern part of the island contiguous to the Port of San Jose (Figure 7.1). This area seems to offer a suitable base for a plated and drained coal yard capable of holding at least 4 million tons in windrows.

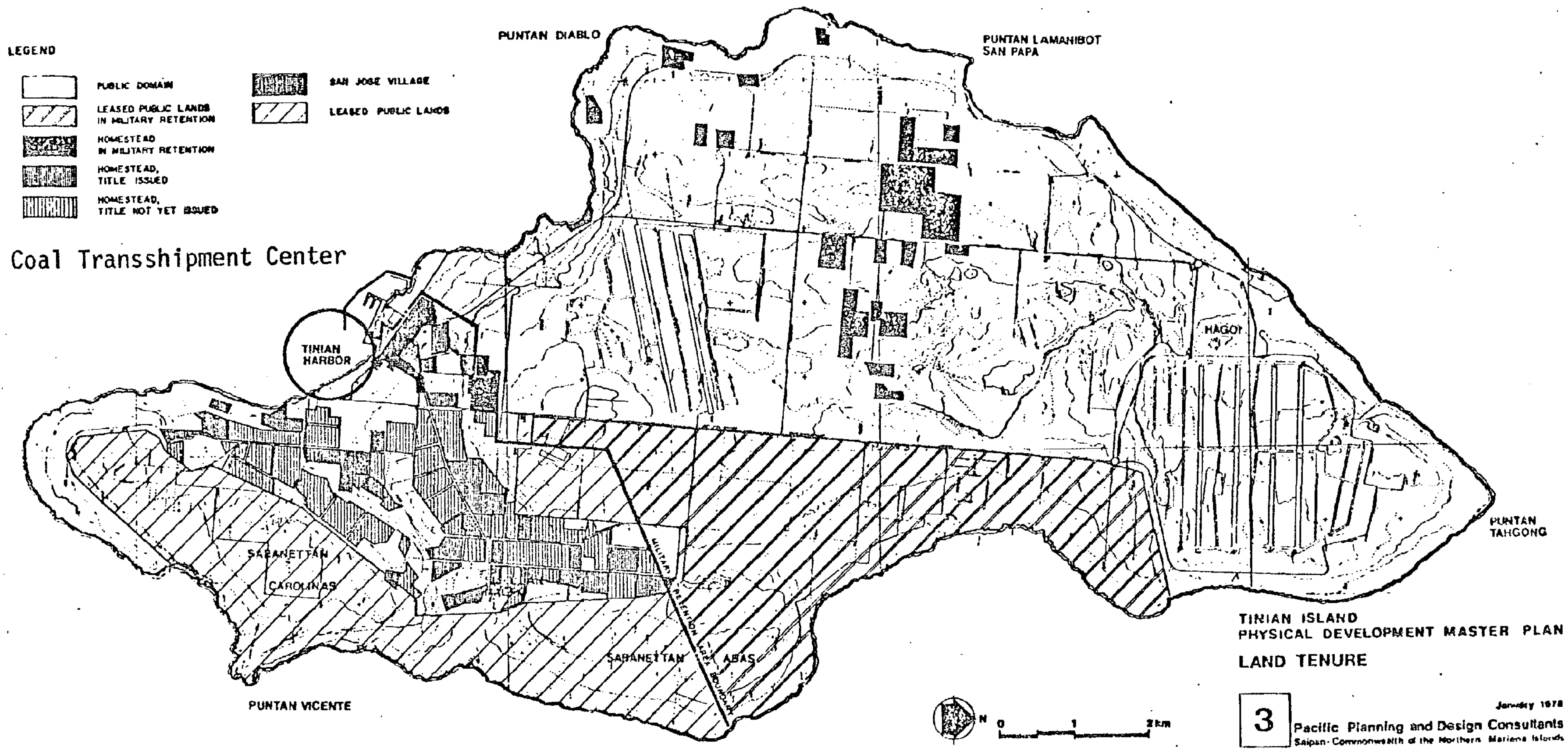


Figure 7.1 Coal Transshipment Center and Adjacent Land Use

Source: Physical Development Plan for CNMI, Tinian, 1978

The harbor of San Jose was dredged during WWII to a depth of 28 to 30 feet in the southern end and where the wharfs and piers were built. A breakwater was built on a reef (Figure 7.2). The harbor lies in a natural basin between the island and the reef. The U. S. Army Corps of Engineers submitted plans for improvements to the harbor consisting of repairs to the north quay wall and a small boat harbor to be constructed in FY 1985/88. If it is not practical to use San Jose for a deep draft harbor with berths for unloading and loading of 150,000 DWT colliers, a site immediately south and east of Gurguan Point may be suitable.

Figure 1.2 showed the general concept of a CTC with a 4-million-tonne ground storage. The colliers would be unloaded by two continuous bucket unloaders, each with a free digging rate of 4000 t/h. The combined net unloading rate is 4400 t/h. The unloading pier dredged depth would be 16.5 m (54.1 ft). The berth length would be 308 m (1010 ft) with unloader reach for the maximum vessel beam of 45 m (147 ft). These dimensions are suitable for a 150,000 DWT collier.

The conveyors inbye of the unloader dock conveyors would flow to any one of the three windrow stacker units at a nominal rate of 4000 t/h. These three stackers would lay up windrows of coal on four 2000 m pads as shown in Figure 1.1. The pads would be plated to prevent seepage and enclosed by berms to contain the drainage or leachate from the piles. The drainage water would be collected in ponds, allowed to settle and filter. The clear water would be recycled to dust control sprays. The coal filtrate would be returned along with the settled coal to the stockpiles.

An agglomerating agent is added at key points to the coal stream on its path to the stockpiles. This agent causes the fines to adhere to the coarse pieces of coal as long as the proper moisture level is maintained at the pile surface. The sprays are located along the stockpiles and are controlled by a weather station on the site (Figure 7.1).

Two bucket wheel reclaimers, each with a capacity of 6000 t/h, will transfer coal from the stockpiles to the outbye belts. The outbye belts feed the dock conveyors to the linear shiploaders. The nominal

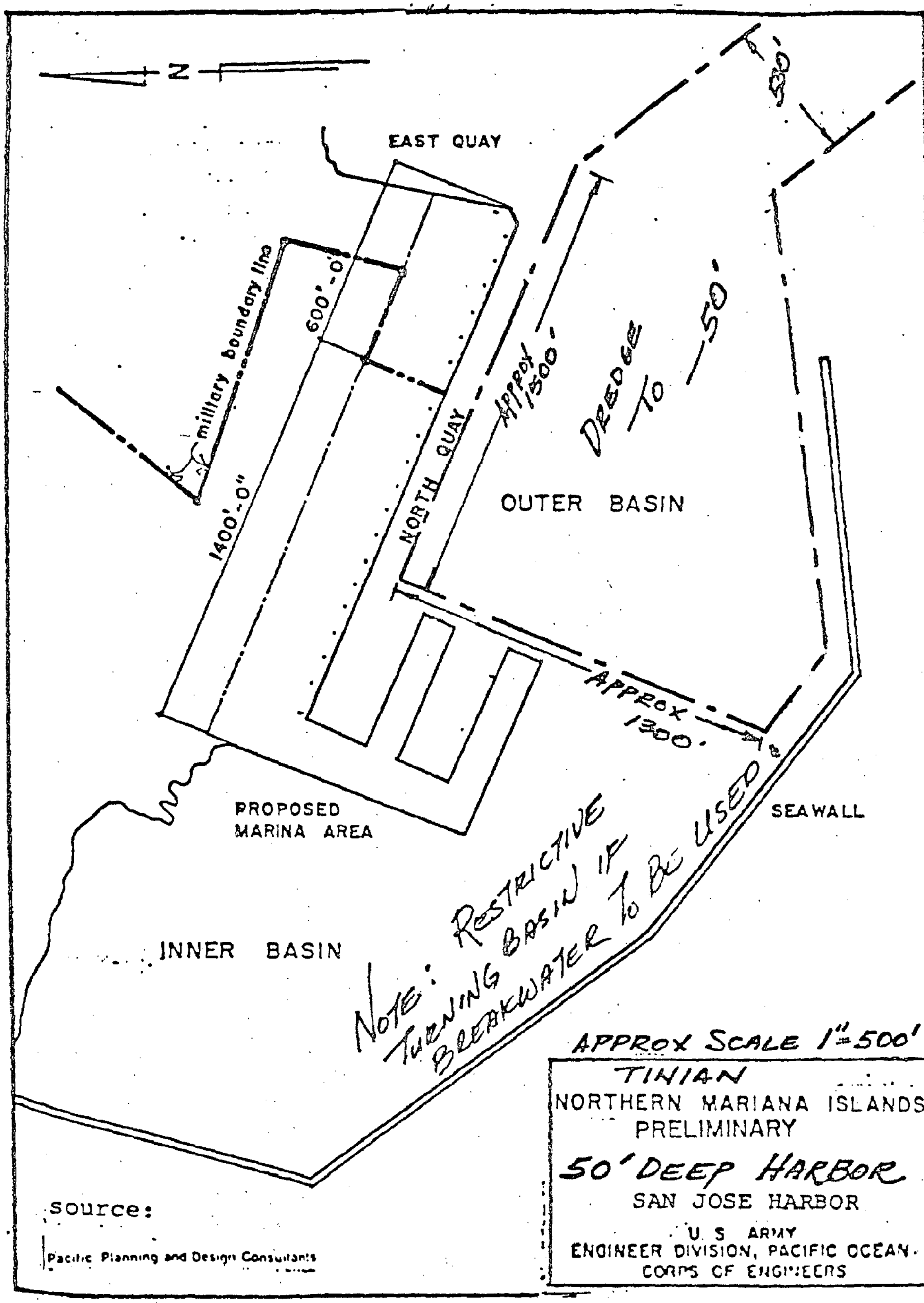


Figure 7.2 San Jose Harbor, Tinian CNMI

loading rate is 6000 t/h. The shiploader pier is also designed for a 150,000 DWT collier. Normally, smaller colliers will be used to ship the coal to the final destination. Figure 7.3 shows some of the standard equipment at a coal transshipping port.

THE COMMERCIAL POTENTIAL OF A TINIAN COAL CENTER

The principal customer for a Coal Center in Tinian would be the Japanese thermal coal consumers. Tinsley (1982) points out that coal imports into Japan, by the most recent estimates, are predicted to range from 45 to 80 Mt in 1990. Present level of imports is at 6.0 Mt. China, USSR and Poland may provide 15% of the supply. The balance will come from Australia, Canada, South Africa and the West Coast of the United States.

Tinsley also points out that many of Japan's ports are primarily involved in handling iron ore and coking coal for the steel mills. The larger part of the thermal coal imports will have to be landed at Coal Centers now under construction and transshipped to coal-fired power plants which in the main are poorly sited for receiving coal in the quantities necessary to enjoy the benefits of the economies of large coal ships.

Tinian has several advantages over the proposed Japanese Coal Centers:

*Tinian has sufficient area available for a larger stockpile area than the proposed Coal Centers.

*Tinian could deliver coal in larger, self-unloading, boom-type coal ships that would not require customer unloading equipment and a minimum mooring facility.

*Tinian could receive coal in large coal carriers operating on a faster turnaround than ships sailing into Japanese waters (Table 7.1).

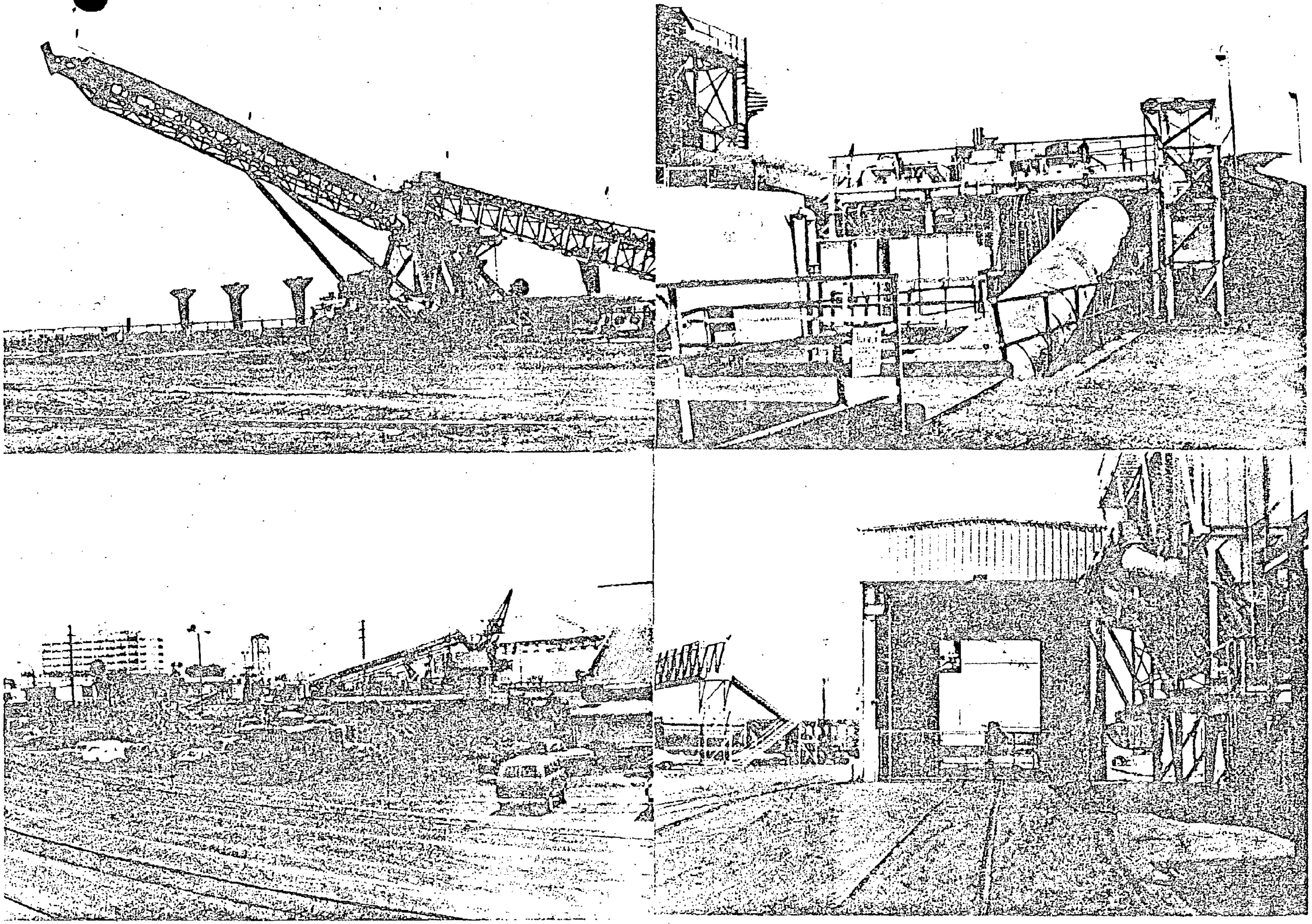


Figure 7.3 Port of Long Beach Coal Exporting Facilities Photos: Actouka 1982

Process	Pollutants	Method of Control
Loading and Unloading at the Dock	Dust	Enclosed conveyers
Land Transport by Conveyor System	Dust	Enclosed conveyors Vacuum cleaners (Similar system used at Long Beach Pier G)
Storage and Stockpiling	Dust Seepage Leachate	Water Sprinklers Windbreakers Plated Pads Enclosed by Berms Bond to Collect Drainage water Dome for Small Amount of Coal
Blending	Dust	Enclosed structure
Combustion	Ash Production Trace Elements Sulfur Oxide Nitrogen Oxide Thermal Pollutants Heated Water	Scrubbers Appropriate Facility Site Use of Ash & Trace Elements in Cement Production

Source: A. J. Dvorak, <u>Impacts of Coal-Fired Power Plants on Fish, Wildlife and Their Habitats</u>, 1978

Table 7.1 Solid, Thermal and Chemical Pollutants from Coal Processes

Table 7.2

Daily Vessel Costs
In U.S. dollars per day
in 1980

	40 (MDWT)	65 (MDWT)	120 (MDWT)	175 (MDWT)
Ownership cost[1]	$ 8597	$ 9826	$13560	$17196
daily operating cost including overhead[2]	4526	5314	5820	8143
Fuel cost/day, at sea	$10038	$13608	$15097	$17247
in port	2658	3488	3877	4267
Total cost/day - at sea	$23161	$28748	$34477	$42586
in port	15781	18628	23257	29606

[1]Includes 10 percent return on investment, 80% of purchase price financed at 8% for 8-1/2 years, 15 year life and zero salvage value.

[2]Includes manning, stores, repairs and maintenance, insurance and administration.

Source: H. P. Drewery Shipping Consultants, Ocean Shipping of Coal, Survey No. 24, October, 1981, pp. 92, 94 and 97.

*The larger stockpiling area at Tinian would permit blending of coal from different sources to produce a more efficient coal for burning in power plants. The Powder River, Wyoming, coal producers are proposing blending with Australian termal coals.

FACILITY CAPABILITIES

Conceptual studies are based on the scheme shown in Figure 1-1. These criteria are detailed below:

*Coal receiving dock proposed is 300m long with 15m draft for 100,000 DWT ore carriers. Unloading equipment would be two continuous bucket-type unloaders, each having a free digging rate of 3000 t/h. Net unloading rate would be 4000 t/h.

*Coal storage and blending area would consist of four windrow piles 25m high by 50m wide. The windrows would be contained laterally by berms incorporated into the elevated subgrade provided for the coal stockpiling and recovery units. The berms would prevent the coal from running onto the equipment tracks, permit 100% machine recovery of the stockpiled coal and contain drainage from the coal piles. The accumulated drainage would be conducted to lateral leachate pond where the water would clarify and be used for dust control. The coal storage area and the leachate pond would be plated with local clay soils as required to prevent seepage. The maximum storage provided would be 4.0 Mt. Use of part of the storage area for blending would reduce the stockpile capacity.

*Coal stacking, blending and reclaiming equipment. Stacking equipment proposed consists of three units operating on the outside and the center of the four coal windrows. The capacity of each stacker and its feeding conveyor would be 4000 t/h. The stackers would work independent of the reclaiming system. Provision would be made to bypass the windrows and transfer coal directly from the unloading to the loading ship. The two bucket wheel reclaimers would each operate between two windrows at a reclaiming rate of 4000 t/h. The reclaiming conveyors would deliver the coal through a transfer point to the ship loading conveyor. Normally, one reclaimer would be operating. Coal stacking and reclaiming operations are independent of each other and could take place simultaneously.

*Shiploading facilities would consist of a dock with a traveling loader or a linear loader with breasting and mooring dolphins. The draft would be 15m in either case to permit loading of a 100,000 DWT coal carrier at a rate of 4000 t/h.

The facilities described above are similar in many details to the newly operational coal terminal facilities at Port Kembla, NSW as described by Paul Soros (1982). The following cost data is extrapolated from this article: (Table 7.3)

Table 7.3 Cost Estimates for Coal Center

	Million $	
Marine Works	10	
Site Works, Foundations	15	
Ship Unloaders	10	
Ship Loader	8	
Material Handling	15	
Stackers	10	
Reclaimers	10	
Total	78	(Accuracy 30% low or 10% high)

An order of magnitude operating cost for a facility of this kind is estimated as follows on an annual basis: (Table 7.4)

Table 7.4 Cost of Operation and Maintenance of the Coal Center

	Million $
Labor, all categories: allow 100 persons at $40,000/annum	4.0
Maintenance, operation materials and services	4.0
Capital charges at 15%	12.0
Subtotal	20.0
CNMI ground rent	10.0
GRAND TOTAL	30.0

Assuming an annual throughput of 10.0M t/a the cost per tonne would be on the order of $3.00. This is the same order of port charges as other Pacific coal ports.

ENUMERATION OF BENEFITS

If there is to be a demand for services of the CTC, there have to be net savings that would accrue to users of the facility. This section examines two possible sources of these savings - economies of scale associated with use of large-size vessels and assurance of uninterrupted supply of coal at lower cost. The last part of the section is devoted to discussion of commercial advantages that may accrue to users and the benefits that accrue to other than user of the CTC.

Savings from Utilization of Large-Size Ships

In most cases the ability to realize economies associated with large-size vessels is the main source of benefits to be derived from the transshipment facility. The sizes of ships used to transport coal have been increasing. The distribution of vessels by size employed in the coal trade, as well as distribution of new order among size classes, indicates a clear trend toward use of larger ships (Table 7.5). This trend is expected to continue in the future (Table 7.6).

The evidence suggests that although there has been a significant increase in sizes of coal transport ships, this trend has a way to go before economies of large-size ships are fully realized. This, in turn, is due to a large extent to draft limits at the export and/or import ports and the size constraints imposed by the Panama Canal. The situation, however, is in the process of being remedied. Ongoing improvement projects will allow major loading ports in the future to handle ships up to 170,000 DWT. Similar improvements are being made at ports unloading metallurgical coal. In Japan, for example, by 1983/84, these ports will be able to handle ships up to 150,000-300,000 DWT. However, as it was pointed out earlier, even by 1990 a large number of ports unloading thermal coal for power stations in Japan will not be able to handle vessels larger than 60,000 DWT.

Other User Savings

There are other potential user savings related to the ability to blend and hold large coal stocks. One of these potential savings pertains to the ability to blend low BTU (8,200-9,700 BUT/lb), low sulphur with high BTU, high sulphur coal to obtain an acceptable blend at net lower cost.

In the normal course of business, the long-term contracts usually cover not more than 90% of the required coal. The remainder is generally purchased at more favorable prices on the stock market. In negotiating stock purchases, as well as long-term contracts, a buyer with stock on hand or with an access to a large area for stockpiling is usually in a favorable position. Likewise, increased lifting of coal prior to price increases is facilitated by having access to available storage areas. Thus, these savings would accrue to the CTC users.

In addition, the relatively short distances between Tinian and Japan would facilitate scheduling of smaller ships, resulting in higher

Table 7.5

Comparison of Size Distribution of New Building Orders For Bulkers With Vessels Already Employed In the Coal Trade

Size Class (DWT x 1000)	% of World Dry Bulk and Combination Carrier Fleet on Order (DWT)	Vessels Employed in the Coal Trade* (% of Cargo Carried)				
		1965	1970	1975	1976	1977
Less than 25	5.7%	63%	40%	29%	25%	23%
25 - 40	23.1	23	21	12	12	10
40 - 60	10.6	11	21	24	24	21
60 - 100	39.5	3	12	25	25	29
above 100	21.1	--	—	10	14	19

Source: H. P. Drewry Shipping Consultants Ltd. (1980)

Table 7.6
Projected Distribution of Steam Coal Shipments In Ton-Miles, By Ship Size (percent)

Year	Ship Size (thousand DWT)							
	20	20-35	35-50	50-80	80-100	100-150	150+	Total
1980	10	13	22	43	5	7	-	100
1985	6	7	19	39	4	17	8	100
1990	4	6	13	27	6	27	17	100
1995	3	5	10	24	6	30	22	100
2000	2	4	8	21	7	33	25	100

Source: H. P. Drewry Shipping Consultants Ltd. (1980)

utilization of power plant unloading facilities. This, in turn, would result in the ability to accept smaller stockpiles on site.

These savings are difficult to quantify since they are likely to be buyer or plant-specific. No attempt, therefore, has been made to assign dollar values to these savings.

Other Non-User Benefits

The CTC may stimulate economic development or increase economic activities both in the immediate surroundings of the CTC or elsewhere in the economy. Low cost coal for energy for industrial use would become available. This could prompt construction of a coal-fired plant with sufficient capacity to service the CTC, the military complex and Saipan (via cable).

8

Utilization Systems

UTILIZATION SYSTEMS

A COAL/RESIDUAL FUEL OIL (RFO)-FIRED MODEL FOR SAIPAN

This model is a preliminary approach to examining the practicality of significantly reducing the electrical energy costs on Saipan by substituting coal-fired generation for the larger part of the oil-fired power generation (Figure 8.1). Initial analysis indicates that the fuel cost savings based on current prices of RFO and Australian low sulfur coal delivered to Saipan are substantial. The current low ratio of RFO cost to coal cost per million Btu of $5.25 to $2.19 at Saipan and $5.57 to $2.10 at Guam, in the opinion of the writer, is artificial and not likely to prevail. A more likely price ratio for the last half of the 1980's is $7.50 to $2.50. A test calculation at this ratio indicates the cash flow from fuel cost savings would approach or exceed the cost of the coal-fired installation. These results, though admittedly preliminary and somewhat superficial due to the lack of good inputs, justify an in-depth study of the potential of coal-fired energy on Saipan.

Input for the model originates from the following sources:

*DOE Territorial Energy Assessment, 1981 (TEA)

*COE Preliminary Port and Harbor Study of the CNMI, 1981 (COE)

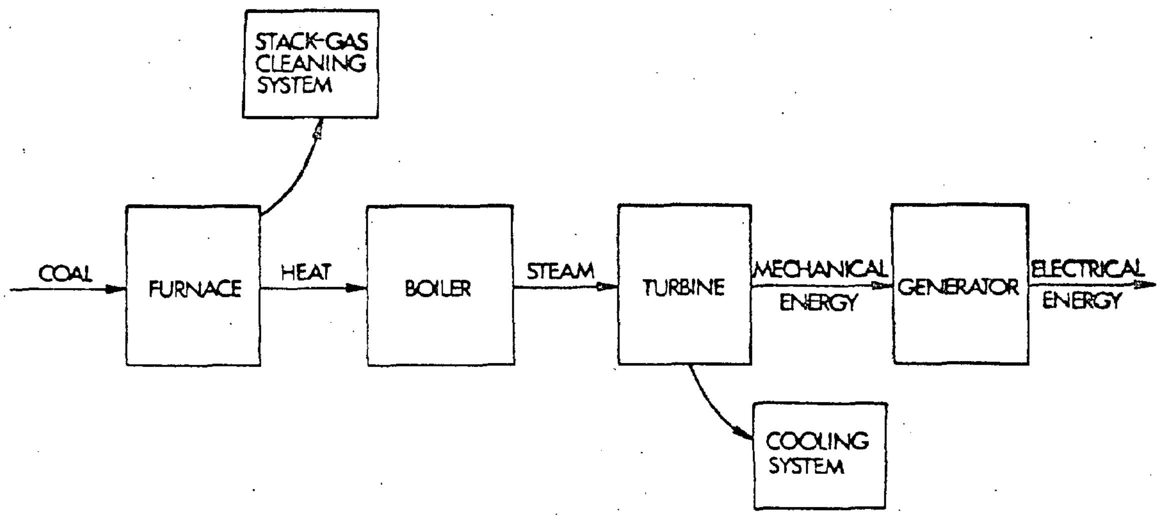
*Stearns-Roger, Coal Feasibility Study for Hawaiian Electric Co. (SR)

*DPED State of Hawaii Data Book, 1981 (DPED)

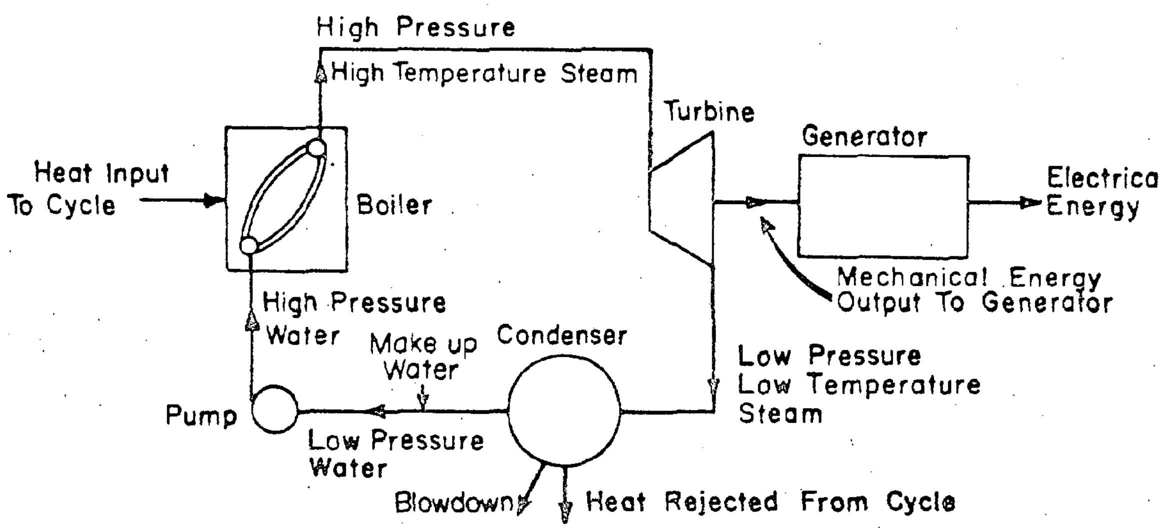
*I.Y. Borg, Coal as an Option for Power Generation in the U.S. Territories of the South Pacific, 1981 (BORG)

*1981 Coking Coal Manual, including thermal coal and anthracite (COM)

*DOE Interim Report of the Interagency Coal Export Task Force, 1981 (CET)



Conversion of Coal into Electrical Energy in a Coal-Fired Power Plant.



The Water/Steam Cycle in a Coal-Fired Power Plant. Modified from U.S. Atomic Energy Commission (1974).

Figure 8.1 Coal-Fired Electric Generation System Components

Source: Impacts of Coal-Fired Power Plants on Fish, Wildlife and their Habitats

The model output is presented in a series of tables as outlined below. Data sources are indicated:

Table 8.1 Projection of the Existing Plant 1980 to 2000.

*Population from PBDC.

*Demand follows the per capita demand experience as given in DPED of 6000 kwh/y. 1980 Saipan demand as shown on TEA p. 75 is 5750 kwh/y. Increase in tourism is expected to increase unit demand per resident.

*Base Load is calculated: Demand/8760 h.

*Peak Load: TEA p. 75 indicates a base to peak load ratio of 10.5 to 14.5 or 1.38. On page 79 the ratio for 1981 and 1986 is shown as 14.8 to 16.5 and 21.8 to 24.2 or 1.11. Table 8.1 uses a ratio of base to peak load of 1 to 1.11.

*Residual Fuel Oil usage if based on TEA p. 75 1980 burn rate of 145,000 bbls for 92.0 million kwh. This is equivalent to 15.106 kwh/gal. HECO 1981 Annual Report, p. 38, shows fuel oil output of 14.04 kwh/gal. by calculation.

*Fuel cost used is $32.11/bbl as per TEA p. 75. TEA p. 34 shows a Guam price of $34.067. The footnote on page 75 indicates that the Saipan price does not include taxes or local transportation.

*Fuel cost per kwh is calculated at $0.051. Guam's price and usage base results in a fuel cost of $0.0579 or 114% of the Saipan cost.

Table 8.1 Saipan Power Demand

Saipan
Existing Plant

Year	Population x 000	Demand GWh	Base Load Mw	Peak Load Mw	Residual Fuel Oil Kbbls.	Fuel Cost M$ 32.11	Fuel Cost Per KWh $
1980	16.0	92.0	10.5	14.5	145	4.66	0.051
81	16.6	99.6	11.4	12.5	157	5.04	0.051
82	17.3	103.8	11.8	13.0	164	5.25	0.051
83	17.9	107.4	12.3	13.5	169	5.44	0.051
84	18.6	111.6	12.7	14.0	175	5.65	0.051
85	19.4	116.4	13.3	14.6	183	5.89	0.051
86	20.0	120.0	13.7	15.1	189	6.07	0.051
87	20.7	124.2	14.2	15.6	196	6.29	0.051
88	21.6	129.6	14.8	16.3	204	6.56	0.051
89	22.4	134.4	15.3	16.9	212	6.80	0.051
90	23.3	139.8	16.0	17.6	220	7.05	0.051
91	24.2	145.2	16.6	18.2	229	7.35	0.051
92	25.1	150.6	17.2	18.9	237	7.62	0.051
93	26.0	156.0	17.8	19.6	246	7.89	0.051
94	27.0	162.0	18.5	20.3	255	8.20	0.051
95	28.1	168.6	19.2	21.2	266	8.53	0.051
96	29.1	174.6	19.9	21.9	275	8.84	0.051
97	30.1	180.6	20.6	22.7	285	9.14	0.051
98	31.1	186.6	21.3	23.4	294	9.44	0.051
99	32.1	192.6	22.0	24.2	304	9.75	0.051
2000	33.1	198.6	22.7	24.9	313	10.05	0.051

There is a great deal of conflicting information in the narrative and tables concerning the current and future energy situation on TEA pp. 75 to 79. A much more specific study of the facilities and operations will be required for a useful preliminary survey of the possibilities for improvement.

Table 8.2 is based on the use of an 18-Mw coal-fired generating unit. This unit was selected to see if using a unit that would not require flue gas treatment would have important savings. Low sulfur Australian coal with a heat content of 12,000 Btu/lb. or 26.4m Btu/tonne was assumed for this table. Washed coal would have an ash content of 8% and a sulfur content of less than 1%. Cost delivered CIF is $60/tonne. This is the same as used on TEA p. 51 in the Guam narrative about conversion to coal.

As indicated in the table footnotes, the coal-fired availability was estimated to be 330 days per year. All other factors are the same as used in Table 8.1.

Table 8.3 is similar to Table 8.2, except a 25-Mw coal-fired plant was used.

In Tables 8.1, 8.2 and 8.3, the coal-fired plant performance was derived from data included in SR Section 5 on coal-fired plant performance for a 25-Mw plant projected for Maui - Hawaii sites. In Tables 8.2 and 8.3 it was assumed that the first full year of coal-fired plant operation would be 1986.

It was also assumed that the coal would be transported by bulk carriers similar to the Australia National Lines Lake Class, which are 16,500 DWT vessels having a length of 486', beam 75', depth 39', and a draft of 28.5'. They would normally carry 16,700 t. These ships are equipped with 3 - 17 ft. deck cranes for unloading cargo. They would unload into dock hoppers which would be serviced by trucks hauling to the plant (Figure 8.2). An arrangement where the hoppers could discharge onto a conveyor belt to the plant store appears to be possible with minimal dredging and pier construction. A simple but efficient coal storage system is shown in Figure 8.3. This will contain dust and other pollutants from storage of coal near power plants.

Table 8.2 Saipan Existing Plant Plus 18 MW Coal Fired Unit

Year	Base Load MW	Peak Load MW	Demand GWh	Coal Fired Output GWh	Coal Use kt	Coal Cost M $/y	RFO Used K bbls.	RFO Cost M $	TOTAL M $
1985	13.3	14.6	116.4				183	5.89	
86	13.7	15.1	120.0	106.4	54.0	3.25	22	0.71	3.96
87	14.2	15.6	124.2	112.4	56.2	3.37	18.5	0.60	3.97
88	14.8	16.3	129.6	117.2	58.6	3.52	19.5	0.63	4.15
89	15.3	16.9	134.4	121.2	60.0	3.63	20.8	0.67	4.30
90	16.0	17.6	130.8	126.7	63.4	3.80	20.8	0.67	4.40
91	16.6	18.2	145.2	131.5	65.7	3.94	21.6	0.70	4.64
92	17.2	18.9	150.6	136.2	68.1	4.09	14.4	0.73	4.82
93	17.8	19.6	152.0	141.0	70.5	4.23	23.7	0.76	4.94
94	18.5	20.3	162.0	142.6	71.3	4.28	30.7	0.98	5.26
95	19.2	21.2	168.6	142.6	71.3	4.28	41.0	1.32	5.60
96	19.9	21.9	174.6	142.6	71.3	4.28	50.6	1.62	5.90
97	20.6	22.7	180.6	142.6	71.3	4.28	60.0	1.92	6.21
98	21.3	23.4	186.6	142.6	71.3	4.28	69.5	2.23	6.51
99	22.0	24.2	192.6	142.6	71.3	4.28	79.0	2.54	6.81
2000	22.7	24.9	198.6	142.6	71.3	4.28	88.5	2.84	7.12

Plant - Stoker fired 18 MW without FG treatment. Data after S-R HECO study.

Nominal Capacity MW		18	
Gross Capacity MW		19.8	
Net Plant Heat Rate Btu/kwh		11820	
Coal Used Btu/lb.		12000	
M Btu/tonne		26.4	
Btu/He 19800 x 11820 M Btu		234	
tonnes/hr.		8.86 use 9.	
Plant Availability			
Planned Maintenance Days	30	Forced Outages Days	5
Net of Days	330	Net of Hours	7920

Table 8.2 Saipan Existing Plant Plus 18 MW Coal Fired Unit

Year	Base Load MW	Peak Load MW	Demand GWh	Coal Fired Output GWh	Coal Use kt	Coal Cost M $/y	RFO Used K bbls.	RFO Cost M $	TOTAL M $
1985	13.3	14.6	116.4				183	5.89	
86	13.7	15.1	120.0	106.4	54.0	3.25	22	0.71	3.96
87	14.2	15.6	124.2	112.4	56.2	3.37	18.5	0.60	3.97
88	14.8	16.3	129.6	117.2	58.6	3.52	19.5	0.63	4.15
89	15.3	16.9	134.4	121.2	60.0	3.63	20.8	0.67	4.30
90	16.0	17.6	130.8	126.7	63.4	3.80	20.8	0.67	4.40
91	16.6	18.2	145.2	131.5	65.7	3.94	21.6	0.70	4.64
92	17.2	18.9	150.6	136.2	68.1	4.09	14.4	0.73	4.82
93	17.8	19.6	152.0	141.0	70.5	4.23	23.7	0.76	4.94
94	18.5	20.3	162.0	142.6	71.3	4.28	30.7	0.98	5.26
95	19.2	21.2	168.6	142.6	71.3	4.28	41.0	1.32	5.60
96	19.9	21.9	174.6	142.6	71.3	4.28	50.6	1.62	5.90
97	20.6	22.7	180.6	142.6	71.3	4.28	60.0	1.92	6.21
98	21.3	23.4	186.6	142.6	71.3	4.28	69.5	2.23	6.51
99	22.0	24.2	192.6	142.6	71.3	4.28	79.0	2.54	6.81
2000	22.7	24.9	198.6	142.6	71.3	4.28	88.5	2.84	7.12

Plant - Stoker fired 18 MW without FG treatment. Data after S-R HECO study.

Nominal Capacity MW	18
Gross Capacity MW	19.8
Net Plant Heat Rate Btu/kwh	11820
Coal Used Btu/lb.	12000
M Btu/tonne	26.4
Btu/He 19800 x 11820 M Btu	234
tonnes/hr.	8.86 use 9.

Plant Availability

Planned Maintenance Days	30	Forced Outages Days	5
Net of Days	330	Net of Hours	7920

Table 8.3 Saipan 2[illegible]W C.F. Plus Exist.

Year	Base Load MW	Peak Load MW	Demand GWh	Coal Fired Output GWh	Coal Use Kt	Coal Cost M $	RFO Use K bbls.	Coal Cost M $	TOTAL M $
1985	13.3	14.6	116.4				183.0	5.89	
86	13.7	15.1	120.0	108.3	50.3	3.02	18.4	0.59	3.61
87	14.2	15.2	124.2	112.4	52.2	3.13	18.6	0.60	3.7
88	14.8	16.3	129.6	117.2	54.4	3.26	19.6	0.63	3.89
89	15.3	16.9	134.4	121.2	56.2	3.37	20.9	0.67	4.00
90	16.0	17.6	130.8	126.7	58.8	3.53	20.7	0.66	4.19
91	16.6	18.2	145.2	131.5	61.0	3.66	21.7	0.70	4.36
92	17.2	18.9	150.6	136.2	63.2	3.79	22.7	0.73	4.5
93	17.8	19.6	156.0	141.0	65.4	3.92	23.7	0.76	4.68
94	18.5	20.3	162.0	146.5	68.0	4.08	24.5	0.79	4.87
95	19.2	21.2	168.6	152.1	70.6	4.23	26.1	0.84	5.07
96	19.9	21.9	174.6	157.6	73.1	4.39	26.8	0.86	5.25
97	20.6	22.7	180.6	163.2	75.7	4.54	27.4	0.88	5.42
98	21.3	23.4	186.6	168.7	78.3	4.70	28.2	0.91	5.61
99	22.0	24.2	192.6	174.2	80.8	4.85	28.6	0.92	5.77
2000	22.7	24.9	198.6	179.8	83.4	5.00	29.7	0.95	5.95

Plant Pulverized Fuel Fired 25MW w/ FG Treatment. Data after S-R HECO study.

Net Output	MW	25
Gross Output	MW	27.6
Net Plant Heat Rate Btu/KWk		11820
Coal Used 12000 Btu/lb or M Btu/tonne		26.4
Coal Usage tonnes/hr.		11.6

Availability:

Planned Maintenance	30 days	Net Available	330 days
Forced Outage	5 days		7920 hours
Total Outage	35		

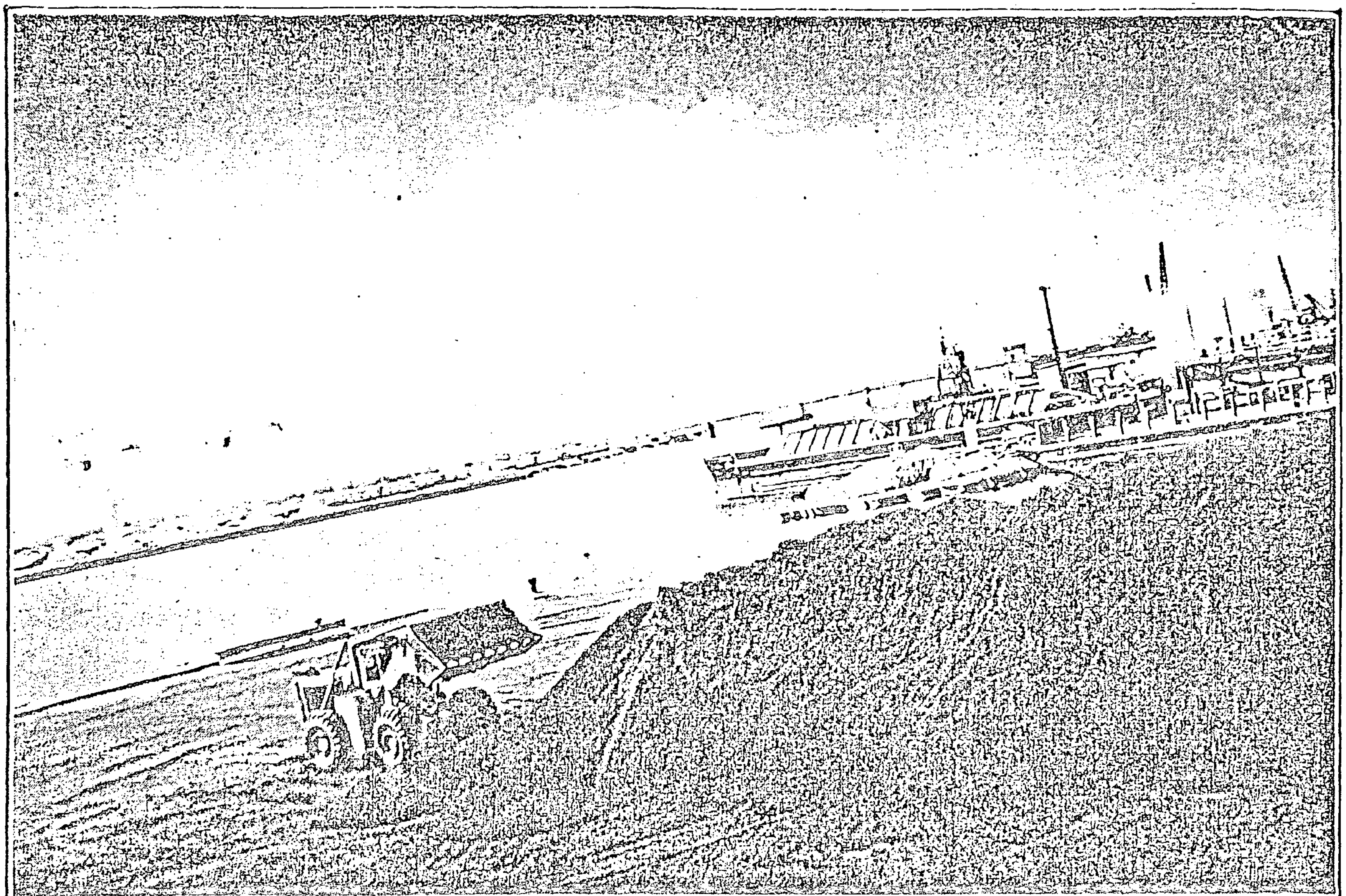


Photo: Actouka '81

Figure 8.2 Australian Coal at Honolulu Harbor

STORAGE CAPACITY & DIMENSION TABLE				
STORAGE CAPACITY IN TONS	"A"	"B"	"C"	"D"
38,000	247'-0	250'-0	86'-6	90'-6
20,500	201'-0	204'-0	70'-6	74'-6
10,500	161'-0	164'-0	56'-6	60'-6

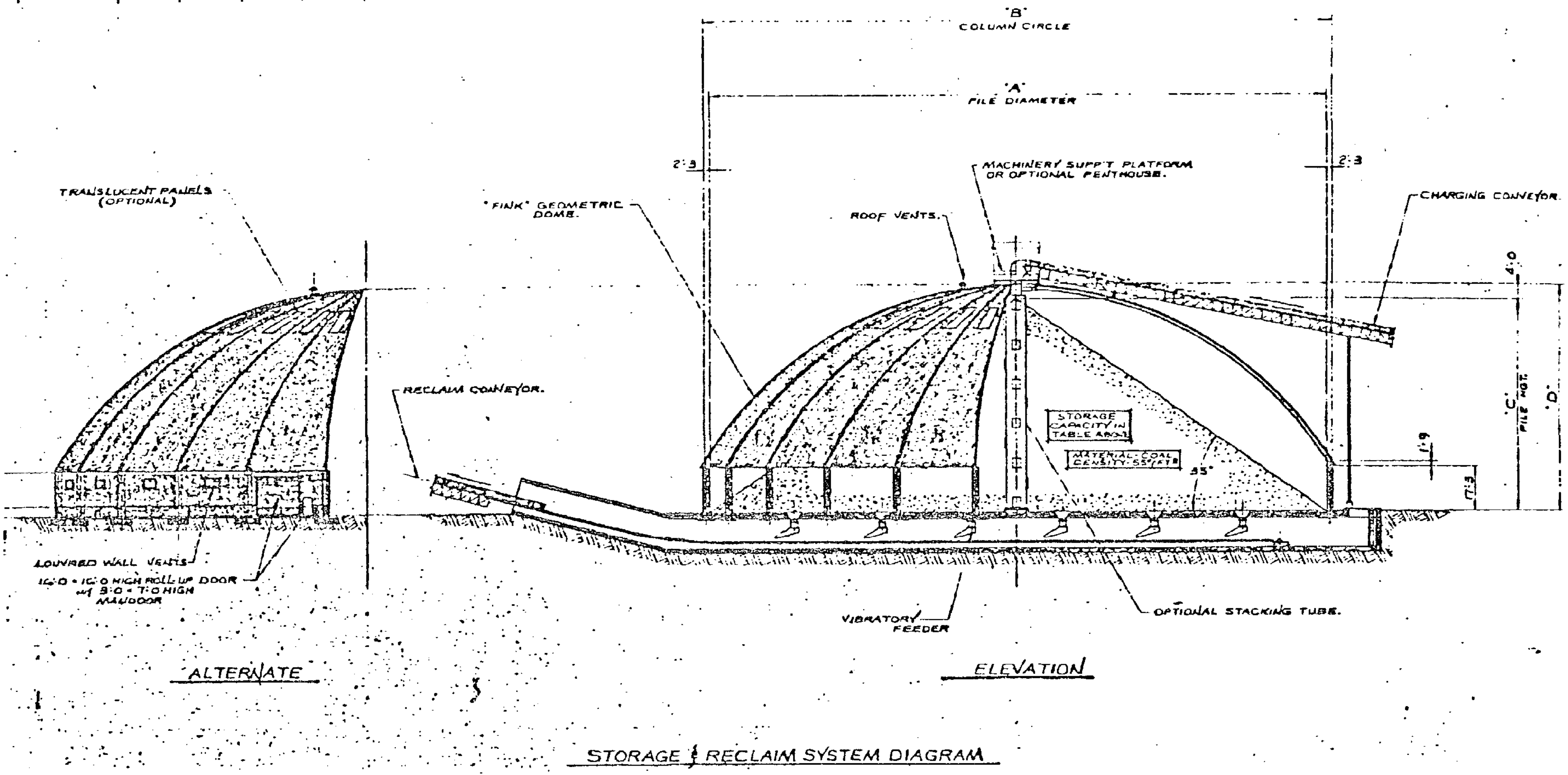


Figure 8.3 Dome enclosure for coal storage of 10,500 - 36,000 tons for pollution control and space saving

Source: Domes, Inc., a division of General Conveyor, Inc., Northern California

Table 8.4 indicates the comparisons of fuel costs between the existing RFO-fired plant and the 18 and 25-Mw plants from 1986 to 2000 inclusive. The savings for the 25-Mw plant are significantly larger, since it can carry a larger part of the load in the later years.

Table 8.5 is based on recalculating the RFO cost on the basis of Guam fuel prices and performance. The fuel price savings of the combined RFO/Coal plant with the 25-Mw unit and the straight RFO plant are substantially larger.

If Guam were to shift to coal, Table 8.6 uses the same input as Table 8.5, but assumes a $45.52/bbl RFO cost and a $68.25/t coal cost. This is equivalent to a $7.50/MBtu cost for RFO and a $2.50/MBtu cost for coal. The three-to-one ratio is a minimum likely ratio for the future. The discounted cash flow return would pay for the steam plant in less than 15 years at a 15% interest rate. This is based on plant costs on the order of $1000 to $1300 per kw or a 25-Mw steam turbine, pulverized, coal-fired plant. The plant would be located adjacent to the existing RFO plant and use the same support facilities for service, maintenance and management. There would not be any land costs and offsite facilities. Coal haulage would be done under contract.

The plant would be set up to handle 25 kt of sodded coal for a stockpile and 25 kt in a storage structure equipped with a recovery feeder used with a front end loader. A 500-t plant silo would hold coal for feeding the pulverizer. The plant is expected to conform to all appropriate EPA regulations regarding emissions, dust, drainage, noise and other offsite impacts.

Fly ash and bottom ash would be collected automatically in separate silos. FGDS sludges would be stabilized with the ash and lime to form a hardened product of low permeability suitable for disposal in a landfill. Alternatively, the ash could be used for roads or as a concrete additive and the FGDS sludges could be used for land plaster.

Saipan's remote location offers some problems from a standpoint of equipment delivery and construction costs. The site does have some advantages, and a high level of interest by the community and its officials can result in an efficient and economically designed facility that will have a positive impact on the island economy.

Table 8.4 Comparisons of Fuel Costs of Tables A and B and A and C*

Year	A	B	A minus B	C	A minus C
1986	6.07	3.96	2.11	3.61	2.46
87	6.29	3.97	2.32	3.73	2.56
88	6.56	4.15	2.41	3.89	2.67
89	6.80	4.30	2.50	4.04	2.76
90	7.05	4.47	2.58	4.19	2.86
91	7.35	4.64	2.71	4.36	2.99
92	7.62	4.82	3.10	4.52	3.10
93	7.89	4.99	2.90	4.68	3.21
94	8.20	5.26	2.94	4.87	3.33
95	8.53	5.60	2.93	5.07	3.46
96	8.84	5.90	2.94	5.25	2.59
97	9.14	6.21	2.93	5.42	3.72
98	9.44	6.51	2.93	5.61	3.83
99	9.75	6.81	2.94	5.77	3.98
2000	10.05	7.12	2.93	5.95	4.10

*Note: Table 8.1 - A
Table 8.2 - B
Table 8.3 - C

Table 8.5 Fuel Cost Comparison of Residual Fuel Oil and Coal

Year	Demand GWh	100% RFO @ 14 KWh/g	"A" 100% RFO @ 34.067/ bbl.	RFO GWh	RFO bbls. @ "G"	"B" RFO Cost @ 34.067	"C" Coal Cost	"D" Total Cost	"A" minus "
	GWh	Kbbls	M$			M$	M$	M$	M$
1986	120^{0}	204	6.95	11.7	21	0.71	3.02	3.73	3.22
87	124^{2}	211	7.20	11.8	21	0.72	3.13	3.85	3.35
88	129^{6}	220	7.51	12.4	21	0.72	3.26	3.97	3.54
89	134^{4}	229	7.79	13.2	22	0.76	3.37	4.13	3.65
90	139^{8}	238	8.10	13.1	22	0.76	3.53	4.29	3.81
91	145^{2}	247	8.41	13.7	23	0.79	3.66	4.45	3.96
92	150^{6}	256	8.73	14.4	25	0.83	3.79	4.62	4.11
93	156^{0}	265	9.03	15.0	26	0.87	3.92	4.79	4.24
94	162^{0}	276	9.39	15.5	26	0.90	4.08	4.98	4.41
95	168^{6}	287	9.77	16.5	28	0.96	4.23	5.19	4.58
96	174^{6}	297	10.11	17.0	29	0.98	4.39	5.37	4.74
97	180^{6}	307	10.46	17.4	30	1.01	4.54	5.55	4.91
98	186^{6}	317	10.81	17.9	30	1.03	4.70	5.74	5.07
99	192^{6}	329	11.17	18.4	31	1.07	4.85	5.92	5.25
2000	198^{6}	338	11.50	18.8	32	1.09	5.00	6.08	5.42

1986 Value of cash flows at 15% interest is $22.84 million.

Table 8.6 RFO and Coal Prices Projected to $7.50 and $2.50/M Btu Guam Burn Rate

	RFO Only		RFO + Coal					
Year	RFO Kbbls.	M$ @ 45.52	RFO Kbbls.	M$ @ 45.52	Coal Kt	M$ @ 68.25	Total M $	Diff. in Fuel Cost
1986	204	9.29	21	0.96	50.3	3.43	4.39	4.90
87	211	9.67	21	0.96	52.2	3.56	4.52	5.15
88	220	10.01	21	0.96	54.4	3.71	4.67	5.43
89	229	10.49	22	1.08	56.2	3.84	4.92	5.57
90	238	10.91	22	1.08	58.8	4.0	5.09	5.82
91	247	11.37	23	1.05	61.0	4.16	5.21	6.11
92	256	11.73	25	1.15	63.2	4.31	5.46	6.27
93	265	12.14	26	1.19	65.4	4.46	5.65	6.49
94	276	12.65	26	1.19	68.0	4.64	5.83	6.82
95	287	13.15	28	1.28	70.6	4.82	6.10	7.05
96	297	13.61	29	1.33	73.1	4.98	6.31	7.30
97	307	14.07	30	1.37	75.7	5.17	6.54	7.53
98	317	14.52	30	1.37	78.3	5.34	6.71	7.81
99	328	15.02	31	1.42	80.8	5.51	6.93	8.09
2000	338	15.49	32	1.47	83.4	5.69	7.16	8.33

Present value
(86) of cash
flows @ 15%.
M$35.02

Borg points out that the generating capacity per capita for Saipan is 1.28 kw while California is 1.0. The HECO annual report for 1981 shows a system-wide factor of 1.66 kw/capita. This includes Oahu, Maui and Hawaii. Assuming that after the delivery of the 8-Mw unit in 1983 the effective generating capacity on Saipan will be about 30 Mw (Figure 8.4), based on Hawaiian standards this would be equivalent to a population of 18,000, the expected level for 1984. If a more conservative factor of 1.5 kw per capita is used, additional generating capacity will be required in 1986. If the suggested 25 Mw plant is put on line at that time and the existing plant is used for peaks and standby, the capacity will be adequate until 2000. It is likely that a lower factor can be applied to a steam plant.

The limited economic review herein does not include any consideration of operating costs, which are generally much lower for a steam coal-fired plant. It has also been assumed that there will be adequate manpower available to run the steam plant and the standby units.

The Australia - Japan shipping route passes very near to Guam. A significant quantity of coal in lots similar to those required by Taiwan, Hong Kong, Singapore, Malaysia, New Caledonia, and smaller industrial users in Japan is available. The business is sought after by coal companies because it is additional revenue with no significant capital layout. The shipments required are approximately the same as used by Hawaii's cement users. Ability to handle large bulk carriers or transshipment of coal is not important to Saipan's requirements. If Guam were to shift to coal, there is a possibility that dual shipments in a larger carrier would offer some price advantage. Presumably, the ship would return to Saipan with a partial cargo. Drafts in the same order of magnitude as projected in the proposed U. S. Army Corps of Engineers program are adequate for any foreseeable coal service to Saipan.

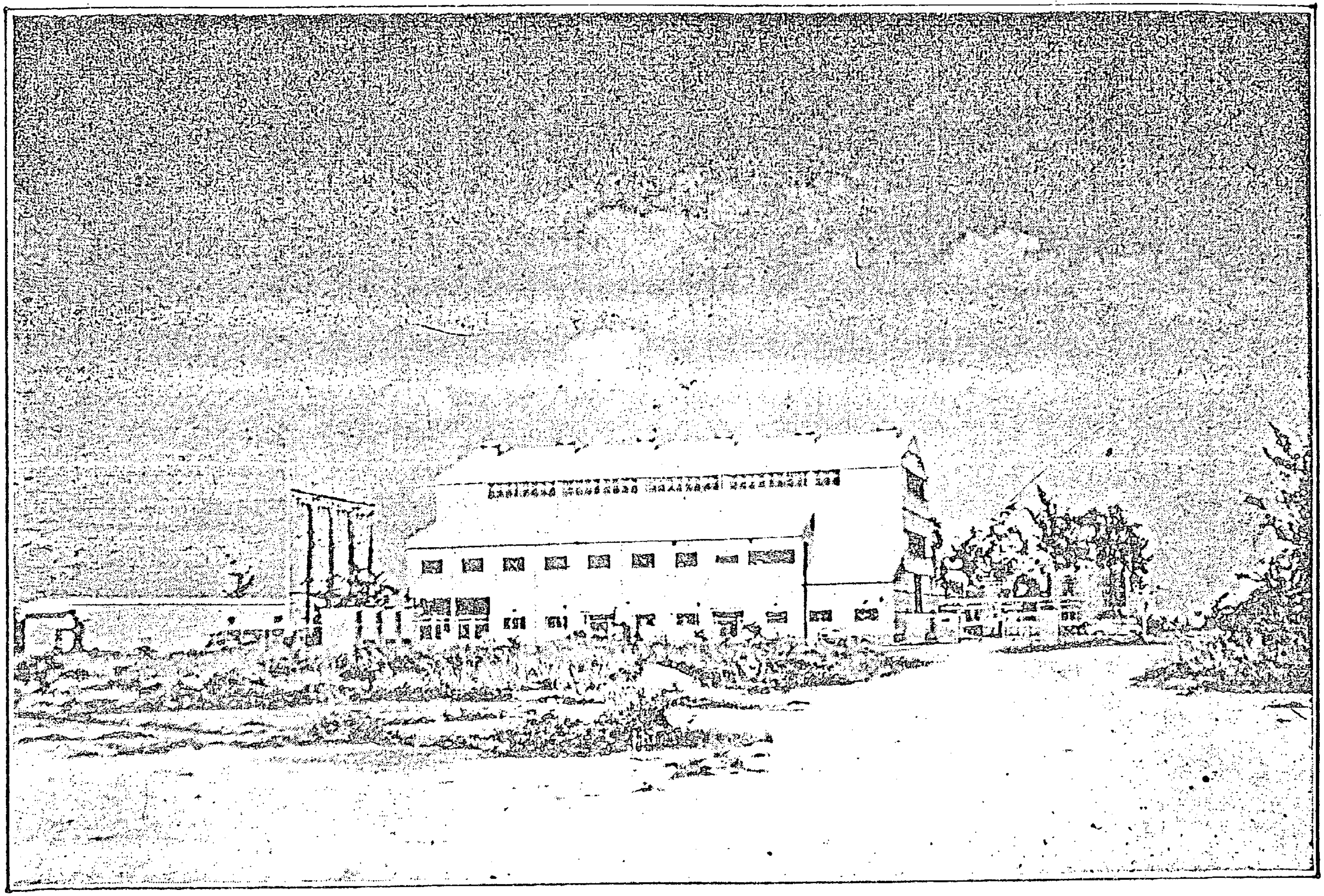


Photo: Actoúka '82

Figure 8.4 Saipan 21 Mwe Power Plant and Substation

9

References

REFERENCES

Berkowitz, N., An Introduction to Coal Technology, New York, 1979.

Borg, I.Y., Coal as an Option for Power Generation in U.S. Territories of the Pacific, Lawrence Livermore National Laboratory, University of California, Livermore, California, 1981.

Borg, I.Y., Technical Considerations Relating to Use of Coal in American Samoa for Power Generation, Lawrence Livermore National Laboratory, University of California, Livermore, California, 1982.

Burns and Roe Pacific, Inc., Bid Evaluation for the Saipan Permanent Power Plant, 1978.

Carter, J. (Ed.), Pacific Island Year Book, 14th Edition (Sydney: Pacific Publications, 1981).

Coal Industry Quarterly, published quarterly by the Securities Research Division, Merrill Lynch, Pierce, Fenner and Smith, Inc.

Coastal Resource Management Office, Issues Related to Construction of a Major Oil Transshipment Facility in the CNMI, 1980.

Coking Coal Manual, 1981 Edition, The Report, Ltd., Tokyo, Japan.

Commonwealth of the Northern Mariana Islands, Overall Economic Development Strategy, Saipan, 1983.

Commonwealth of the Northern Mariana Islands Energy Office, Renewable Energy, 1982.

Commonwealth of the Northern Mariana Islands Government, Commonwealth Register, 1981.

Doerell, P. E., "Seaborne Steam Coal Trade May Quadruple in 1990," World Coal, Vol. 7, No. 2, 1981, pp. 27-28.

Goplerud, C. P. III, Coal Development and Use, Lexington Book, Mass., 1983.

Hargreaves, D., Australian Bulk Ports and Shipping - Can They Meet the Challenge of the 80s, Bulk Solids Handling, Vol. 1, p. 565, 1981.

H. P. Drewery Shipping Consultants, Ltd., Changing Ship Type/Size Preferences in the Dry Bulk Market (London: HPD Publications, 1980).

Jennings, W., How to Negotiate and Administer a Coal Supply Agreement, McGraw-Hill, Inc., 1981.

Joint Coal Board, Thirty-Fourth Annual Report, 1980-1981, Sydney, February 9, 1982.

Kajakoski, P., Stacking, Blending and Reclaiming of Coal, Bulk Solids Handling, Vol. 1, p. 105, 1981.

Keller and Gannon, Saipan Power System Improvement Study, 1981.

Kimura, T., Demand for Imported Steam Coal in Asian Countries, The Institute of Energy Economics, Tokyo, Japan, 1983.

Knights, R. I., Coal Loading Facilities in the Port of Newcastle, Bulk Solids Handling, Vol. 1, p. 573, 1981.

Merrill Lynch, Pierce, Fenner & Smith, Inc., Coal Industry Quarterly, June 1982.

National Energy Advisory Committee, Strategies for Greater Utilization of Australian Coal, Australian Government Publishing Service, Canberra, 1980.

Nishimoto, N., Forecast and Record of Power Generation, 1982.

OECD (Organization for Economic Cooperation and Development), Maritime Transport 1981, Maritime Committee, Paris, 1982.

Okura, G. N. and G. A. Chapman, Hawaii Deep Water Electrical Transmission Cable Demonstration Program, 1982.

Page, R. P. and Farragut, P. R., "Export Coal: Implications for U.S. Ports," Transportation Research Forum, Proceedings of the 22nd Annum Meeting, Vol. 22, No. 1, 1981, pp. 112-120.

Peters, W., et al, Coal Resources, IPC Science of Technology Press, New York, 1978.

Port and Marine Task Group, Western U.S. Steam Coal Exports to the Pacific Basin, report prepared by the Port and Marine Task Group, Western Coal Export Task Force, Pacific Basin Steam Coal Export Study (Denver: Western Governors' Policy Office, 1981).

Power Generation Branch, Letter to Director of Public Works, (CNMI Government), 1982.

Robert Panero Associates, A Proposal for the Development of an International Transshipment and Petroleum Storage Port, District of Palau, Western Caroline Islands, Trust Territory of the Pacific, Port Pacific Corporation, 1975.

Robinson, G., Leith Coal Outloading Plant, Bulk Solids Handling, Vol. 2, p. 111, 1982.

Joint Coal Board, Thirty-Fourth Annual Report, 1980-1981, Sydney, February 9, 1982.

Kajakoski, P., Stacking, Blending and Reclaiming of Coal, Bulk Solids Handling, Vol. 1, p. 105, 1981.

Keller and Gannon, Saipan Power System Improvement Study, 1981.

Kimura, T., Demand for Imported Steam Coal in Asian Countries, The Institute of Energy Economics, Tokyo, Japan, 1983.

Knights, R. I., Coal Loading Facilities in the Port of Newcastle, Bulk Solids Handling, Vol. 1, p. 573, 1981.

Merrill Lynch, Pierce, Fenner & Smith, Inc., Coal Industry Quarterly, June 1982.

National Energy Advisory Committee, Strategies for Greater Utilization of Australian Coal, Australian Government Publishing Service, Canberra, 1980.

Nishimoto, N., Forecast and Record of Power Generation, 1982.

OECD (Organization for Economic Cooperation and Development), Maritime Transport 1981, Maritime Committee, Paris, 1982.

Okura, G. N. and G. A. Chapman, Hawaii Deep Water Electrical Transmission Cable Demonstration Program, 1982.

Page, R. P. and Farragut, P. R., "Export Coal: Implications for U.S. Ports," Transportation Research Forum, Proceedings of the 22nd Annum Meeting, Vol. 22, No. 1, 1981, pp. 112-120.

Peters, W., et al, Coal Resources, IPC Science of Technology Press, New York, 1978.

Port and Marine Task Group, Western U.S. Steam Coal Exports to the Pacific Basin, report prepared by the Port and Marine Task Group, Western Coal Export Task Force, Pacific Basin Steam Coal Export Study (Denver: Western Governors' Policy Office, 1981).

Power Generation Branch, Letter to Director of Public Works, (CNMI Government), 1982.

Robert Panero Associates, A Proposal for the Development of an International Transshipment and Petroleum Storage Port, District of Palau, Western Caroline Islands, Trust Territory of the Pacific, Port Pacific Corporation, 1975.

Robinson, G., Leith Coal Outloading Plant, Bulk Solids Handling, Vol. 2, p. 111, 1982.

Sasadi, J., Latest Developments in Coal Handling for Self-Unloading Ships and Barges, Bulk Solids Handling, Vol. 2, p. 383, 1982.

Shibukawa, K., Statement of Japanese Steam Coal Forecast, Hearings of the Subcommittee on Energy and Mineral Resources, Energy and Natural Resources Committee, U. S. Senate, December 1, 1981.

Shore, M., "Overall Economics in Transportation of Coal for Export," in Critical Issues in Coal Transportation Systems: Proceedings of Symposium (Washington, D.C.: National Academy of Sciences, 1979).

Simeons, C., Coal: Its Role in Tomorrow's Technology, 1978.

Soros, P., Conneaut-An Economical Superport, Bulk Solids Handling, Vol. 2, p. 413, 1982.

Soros, P., Port Kembla Coal Terminal, The International Journal of Storing and Handling Bulk Materials, Vol. 1, No. 4, December 1981, pp. 587-594.

Soros, P., Port Kembla - A State of the Art Coal Port, The International Journal of Storing and Handling Bulk Materials, Vol. 3, No. 1, March 1983, pp. 85-91.

Tinsley, R. C., Economics of Pacific Rim Coal, in Li, T.M., Brown, G.R., and Guernsey, N.C. (Editors), Mineral Resources of the Pacific Rim, Proceedings of the Special Programming by the Minerals Resource Management Committee during the First International SME-AIME Fall Meeting, Honolulu, Hawaii, September 2-9, 1982, pp. 113-122.

Toichi, T. and K. Furuto, Outlook for Japan's Economy and the Energy Supply and Demand Structure for the 1980s, Energy in Japan, Bimonthly Report No. 62, The Institute of Energy Economics, Tokyo, Japan, March 1983, pp. 11-29.

Uehara, T., Pacific Rim Coal Markets, Hearings of the Subcommittee on Energy and Mineral Resources, Committee on Energy and Natural Resources, U. S. Senate, December 1, 1981.

U. S. Army Corps of Engineers, Port and Harbor Study for CNMI, 1981.

U. S. Army Corps of Engineers, Saipan Small Boat Harbor, 1981.

U. S. Department of Energy/Department of Interior, Territorial Energy Assessment, 1981.

U. S. General Accounting Office, Alternatives to the Northern Mariana Islands Lease, 1982.

Venator, T. J., Applications Aspects of Continuous Unloaders, Bulk Solids Handling, Vol. 2, p. 107, 1982.

Waters II, W.G., "Transportation and Market Prospects in the World Coal Trade," The Logistics and Transportation Review, Vol. 18, No. 2, June 1982.

1982 Australian Coal Conference Papers, Australia: Surfers Paradise, April 19-22, 1982.

10

Appendixes

DEFINITIONS (Adapted from The Direct Use of Coal and Port Pricing and Investment for Developing Countries)

All-in charges: Single charge for all services.

Alongside: With the vessel standing at the quay or jetty, the cargo is moved from ship direct to surface of quay (or in inverse direction). Opposite: overside.

Anthracite Coal: A hard, high rank coal with high fixed carbon.

Ash (fly ash): Lightweight solid particles that are carried into the atmosphere by stack gases.

Base Load: The minimum load of a utility, electric or gas, over a given period of time.

Berth: Section of quay (pier, wharf, or jetty) notionally designed to accommodate one vessel and including a section of the surface over which labor, equipment, and cargo move to and from the vessel. By transference, in ship owner's language, service to a port.

Berthing fee (or charge): A charge levied by certain ports on the vessel to pay for the use of the berth (and not always payable, or fully payable, if the ship stays mid-stream).

Bituminous Coal: The coal ranked below anthracite. It generally has a high heat content and is soft enough to be readily ground for easy combustion. It accounts for the bulk of all coal mined in this country.

Break-bulk (cargo): Cargo packed in separate packages (lots or consignments) or individual pieces of cargo, loaded, stowed, and unloaded individually; as distinct from bulk cargo.

BTU: British thermal unit, a measure of the energy required to raise one pound of water one degree Fahrenheit.

Bulk carriers; bulker: Ship designed to carry bulk, nonliquid cargo.

CFS: Container freight station.

Channel: Passage of water leading to the port that is normally dredged and policed by the port authority.

Channel dues: Charge levied (on the vessel) for using the channel.

Charter rate: Payment by charterer (such as cargo owner) to ship owner for the charterer (such as cargo owner) to ship owner for the charter of the vessel. It is determined by market conditions and terms of charter.

c.i.f.: Cost + insurance + freight. This corresponds in principle to the landed price of shipments before tax.

Coal gasification: The process that produces synthetic gas from coal.

Coal liquefaction: Conversion of coal to a liquid for use as synthetic petroleum.

Coaster: Ship that plies between coastal ports on the same coast or archipelago or in interisland trades.

Commercial Sector: A subsector of service industries that includes wholesale and retail trade, schools and other government nonmanufacturing facilities, hospitals and nursing homes, and hotels. As defined, this sector does not include transportation and household services.

Conference (liner or steamship conference): A combination (technically, a cartel) of shipping companies (or owners) which sets common liner freight rates on a particular route and which regulates the provision of services.

Cranage: A port charge levied for the use of cranes. It is paid by ship or cargo owner or by both parties in certain proportions according to the customs of the port.

DWT: Dead weight tonnage. The weight in long tons that a vessel can carry when fully laden.

Effluent: Any water flowing out of an enclosure or source to a surface water or groundwater flow network.

Elasticity: The fractional change in a variable that is caused by a unit change in a second variable. Income elasticities are important in energy estimates, since these estimate the changes in quantities of energy demanded as incomes change.

FCL: Full container load; a container that is delivered to the shipping company full of the consignor's cargo. The meaning changes according to who uses the term; ports may describe containers as FCL if they leave the port's area without having been unstuffed (or stripped).

Feeder (service): Transport of containers which are first carried by the main line container vessel to a port of transshipment, unloaded, and then loaded on a smaller vessel for feeding to a further port. Feeder service implies transshipment.

Flue-gas desulfurization: The use of a stack scrubber to reduce emissions of sulfur oxides. See stack scrubber.

f.o.b.: Free on board. In the case of ocean carriage it means the value of the goods (including the value of packing) when placed on board the vessel. It includes such charges as the shipper had to pay to the port but excludes cargo insurance (and freight) and corresponds only approximately to market value in the exporting country.

Freight tons: A heterogeneous unit for counting cargo or traffic in liner shipping. It is based on the rules by which freight rates are assessed. For cargo paid by weight tons, the weight ton (long, short, or metric) is a freight ton. For cargo paid for by measurement tons (for example, 40 cubic feet), the measurement ton is the freight ton.

General cargo: Cargo, not homogeneous in bulk, which consists of individual units or packages (parcels).

Greenhouse effect: The potential rise in global atmospheric temperatures due to an increasing concentration of CO_2 in the atmosphere. CO_2 absorbs some of the heat radiation given off the Earth, some of which is then reradiated back to the Earth.

GRT: Gross register tonnage, a measure of the total space of a vessel in terms of 100 cubic feet (equivalent tons) including mid-deck, between deck, and the closed-in spaces above the upper deck, less certain exemptions. The GRT of most of the world's ships is recorded in Lloyds Register. See also, NRT and DWT.

Gross energy demand: The total amount of energy consumed by direct burning and indirect burning by utilities to generate electricity. Net energy demand includes direct burning of fuels and the energy content of consumed electricity. The difference between gross and net energy demand is a measure of the energy losses by utility conversion to electricity. The difference between gross and new energy demand is a measure of the energy losses by utility conversion to electricity. About two-thirds of the energy input at the utility is lost in generation and transmission.

Gross National Product (GNP): The value of all goods and services produced in a given year. GNP is a "value added" concept. It is stated in either current or constant (real) dollars.

Groundwater: Subsurface water occupying the saturation zone from which wells and springs are fed; in a strict sense, this term applies only to water below the water table.

Heat pump: A device that moves heat from one environment to another. In the winter it moves heat from the outside of a building to the inside, and in the summer it moves heat from the inside to the outside.

Hook: Loading and discharging point along a vessel; the hook is lowered by ship's derrick or crane to receive the net holding the cargo. Hence, hook hours, the base of a measure of port output (cargo tons moved per hook hour).

Industry: Industry is an aggregate of three sectors - manufacturing, mining, and construction.

Joule: A unit of energy which is equivalent to 1 watt for 1 second. 1 Btu - 1,055 Joules.

Labor force: The number of persons 16 years of age or older who are either employed or actively looking for work.

Landing charges: A charge levied by certain ports on the cargo owner for receiving and handling imports. The corresponding charge for exports is called shipping charge.

Lash: Lighter aboard ship. This is a technique of water transport by which cargo is loaded on barges which are in turn taken up by an ocean vessel which transports them and ultimately releases them to carry the cargo into port.

LCL: Less than container load; cargo destined for shipment in a container that is delivered by the consignor for consolidation with other cargo and insertion in a container by the shipping company at a container freight station.

Lignite: The lowest rank coal from a heat content and fixed carbon standpoint.

Measurement ton: A unit of quantity of cargo based on its cubic measurement (for example, 40 cubic foot or 1 cubic meter).

Metallurgical coal: Coal used in the steelmaking process. Its special properties and difficulty of extraction make it more expensive than steam coal.

Methane: CH4, carburated hydrogen or marsh gas formed by the decomposition of organic matter. It is the most common gas found in coal mines.

NRT: Net register tonnage, the GRT minus the spaces that are non-earning - machinery, permanent bunkers, water ballast, and crew quarters. Over the range 0 to 6,000 NRT there is a reasonably good correlation between NRT and DWT: DWT = 2.5 NRT.

One-off visit: A nonroutine or nonschedule call at a port.

Overside: Cargo being loaded or unloaded from ship into barges standing along the vessel. Opposite: alongside.

Pallet (palette): Tray or other solid base on which cargo is loaded for loading or unloading; a form of unitized cargo (palletized). Pallet ships are designed to carry cargo piled on pallets.

Particulate matter: Solid airborne particles, such as ash.

Peak power: The maximum amount of electrical energy consumed in any consecutive number of minutes, say 15 or 30 minutes, during a month.

Port dues: A charge levied by certain ports on the vessel or cargo.

Process steam and heat: Steam and heat produced for industrial process uses, such as the activation of drive mechanisms and product processing.

Productivity: The value of goods or services produced by a worker in a given period of time, such as one hour. For the United States, in 1975, this averaged $7.39. Increases in output over time are used to measure gains in productivity. A variety of time periods is used, including output per worker per year. Also, productivity statements often refer to gains in private sector output per worker rather than output in the total economy.

Quad: One quadrillion (1015) British thermal units (Btu).

Quay charges (rent): A port charge levied on the vessel for the use of the quay.

Reserves: Resources of known location, quantity, and quality which are economically recoverable using currently available technologies.

Residential sector: Includes all primary living units - houses, apartments and mobile homes. Households are classified as follows: a) family households, which incorporate persons who are either married or blood related; b) primary individual households, which are made up either of single persons or incorporate two or more persons who are neither married nor blood-related.

Resources: Mineral or ore estimates that include reserves, identified deposits that cannot presently be extracted due to economical or technological reasons, and other deposits that have not been discovered but whose existence is inferred.

Retrofit: A modification of an existing structure, such as a house or its equipment, to reduce energy requirements for heating or cooling. There are basic types of retrofit: equipment, such as a heat pump replacing less efficient equipment; and insulation, storm doors, calking, etc., designed to lower energy requirements.

Roll-on/roll-off: Cargo carried in wheeled containers or wheeled trailers aboard and moving onto the ship and off it on wheels, usually over ramps.

Seam: A bed of coal or other valuable mineral of any thickness.

Ship measurements: Measures of cubic capacity, in tons of 199 cubic feet; see GRT, NRT, and DWT.

Slurry pipeline: A pipeline that conveys a mixture of liquid and solid. The primary application proposed is to move coal long distances (over 300 miles) in a water mixture.

Stack scrubber: An air pollution control device that usually uses a liquid spray to remove pollutants, such as sulfur dioxide or particulates, from a gas stream by absorption or chemical reaction. Scrubbers are also used to reduce the temperature of the emissions.

Steam coal: Coal suitable for combustion in boilers. It is generally soft enough for easy grinding and less expensive than metallurgical or anthracite coal.

Stevedore: Labor employed to load and unload cargo and, by transference, the organizer of this work. In many ports, stevedores only work aboard ships for the account of vessel or cargo owner, and work ashore is done by the port's labor.

Subbituminous coal: A low rank coal with low fixed carbon and high percentages of volatile matter and moisture.

Sulfates: A class of secondary pollutants that includes acid-sulfates and neutral metallic sulfates.

Sulfur: An element that appears in many fossil fuels. In combustion of the fuel the sulfur combines with oxygen to form sulfur dioxide.

Sulfur dioxide: One of several forms of sulfur in the air; an air pollutant generated principally from combustion of fuels that contain sulfur.

Supply: The functional connection between the price of a good and the quantity of that good that some agent is willing to sell at that price. The supply function is generally positive, or (geometrically speaking) up-sloping, meaning that as the price goes up, the quantity supplied also goes up.

Swing fuel: A fuel that plays a key role during the transition from exhaustible to inexhaustible fuels. Coal is viewed by many as the swing fuel during the transition.

Synthetic fuel: A fuel produced by biologically, chemically, or thermally transforming other fuels or materials.

TEU: Twenty-foot equivalent unit. Standard unit for counting (equivalent) containers of various dimensions: 20 x 8 x 8 feet; in other words, a 20-foot equivalent container.

Transportation sector: Includes five subsectors: 1) automobiles; 2) service trucks; 3) truck/bus/rail freight; 4) air transport; and 5) ship/barge/pipeline.

Trampers (Tramps): Nonscheduled, nonconference vessels.

Transit shed: A shed in the port area, usually in customs-bonded area, which is positioned behind the berth to receive cargo unloaded from vessel or for loading. Distinct from warehouse.

Unit train: A system for delivering coal in which a string of cars, with distinctive markings and loaded to full visible capacity, is operated without service frills or stops along the way for cars to be cut in and out.

Unitized cargo: Cargo packed in units for easy presentation to vessel and port; for example, containered cargo and palletized cargo.

Western coal: Can refer to all coal reserves west of the Mississippi. By Bureau of Mines definition, includes only those coalfields west of a straight line dissecting Minnesota and running to the western tip of Texas. Wyoming and Montana (subbituminous) and North Dakota (lignite) have the largest reserves.

Wharfage: A charge levied by some ports on the cargo owner for the use of the port surface over which the cargo moves.

PRIMARY PERSONNEL CONTACTED IN CNMI

Government

Pedro P. Tenorio	Governor
Pedro A. Tenorio	Lt. Governor
Olympio T. Borja	Senate President
Benigno R. Fitial	Speaker of the House
Herman M. Manglona	Mayor, Tinian
Prudencio T. Manglona	Mayor, Rota
Ramon S. Guerrero	Special Assistant to the Governor, CNMI
Gloria Hunter	Special Assistant for Programs and Legislative Review
George Chan	Acting Special Assistant for Planning and Budget
Ivan Groom	Physical Planning Office
Ignacio M. Sablan	Consultant to the Special Assistant to the Governor for Planning and Budget
Manny T. Sablan	Acting Program Coordinator, Coastal Resources Management
Herman Guerrero	Washington Office
George Ehlers	Physical Planning
Nick Songsong	Rota, Labor and Commerce
Tony Tenorio	Consultant to Public Works
Masahiro Nishimoto	Power Plant Branch Supervisor, Department of Public Works
Ben Sablan	Acting Director of Public Works, Tinian
Antonio C. Mona	Chief of Labor
Henry U. Hofschneider	Tinian, Marianas Public Land Corporation
William R. Concepcion	Chief Planner, MPLC
Jose R. Lifoifoi	Chairman, Resources and Development, House of Representatives

Private Sector

David M. Sablan	President, MICROL Corporation
Alfred Santos	President, Saipan Stevedore Company
Don Conner	Tinian, Stevedores, Inc.
Jose A. Songsong	Assistant Executive Director, Ports Authority

CONTACTS AND COAL-RELATED INDUSTRIES

William D. Aldenderfer
Vice President
Pacific Resources, Inc.
PRI Tower
733 Bishop Street
P. O. Box 68
Honolulu, Hawaii 96810

Alvin L. Alm
Director
Harvard Energy Security Program
J. F. Kennedy School of Government
Harvard University
79 John F. Kennedy Street
Cambridge, Massachusetts 02138

Ian Coddington
General Manager
Energy Marketing Division
CSR, Ltd.
One O'Connell Street
Sydney 2000, Australia

Loren C. Cox
Director
Center for Energy Policy Research
Energy Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

Department of Mineral Resources
8 Bent Street
CACA Centre
Sydney, NSW 2000

Department of Mines
Mineral House
41 George Street
Brisbane, Queensland 4000

Daniel A. Dreyfus
Director
Energy Forecasting and Analysis
Gas Research Institute
1019 19th Street, N.W.
Washington, D. C. 20036

Electric Power Development Co., Ltd.
8-2 Morunouchi 1-Chome
Chiyoda-ku
Tokyo 100, Japan

Donald G. Fleming
Director of Public Relations
The Port of Long Beach
925 Harbor Plaza
P. O. Box 570
Long Beach, California 90801

Maridell A. Foster
Senior Marine Biologist
SEACO, Inc.
146 Hekili Street
Kailua, Hawaii 96734

Japan Coal Development Company
2nd Floor, Kokoryu-Koen Building
No. 6-15, Shiba Koen, 2-Chome
Minato-Ku
Tokyo 105, Japan

Joint Coal Board
Sinius House
23 Macquarie Place
Sydney, NSW 2000

John E. Keith
Associate Professor
Resource & Environmental Economics
Department of Economics
Utah State University
Logan, Utah 84322

James Maragoes
Chief of Environmental Resources Section
Planning Branch
U. S. Army Corps of Engineers
Building 230
Ft. Shafter, Hawaii 96859

Kenichi Matsui
The Institute of Energy Economics
Sai-Ju 10 Mori Building
1-18-1 Toranomon
Minato-ku
Tokyo 105, Japan

James H. McJenkin
Executive Director
The Port of Long Beach
925 Harbor Plaza
P. O. Box 570
Long Beach, California 90801

George W. Mead
Director, Coal Marketing
Pacific Resources, Inc.
PRI Tower
733 Bishop Street
P. O. Box 68
Honolulu, Hawaii 96810

Yasuhiro Murota
Institute for Policy Science
Saitama University
3-23-1 Kataseyama
Fujisawa
Kanagawa, Japan 251

Gunnor Ose
Vice President
Head of Bulk Commodities Group
R. S. Platona. S
Dronning Maude, Gate 3
P. O. Box 1357 Vika
01501, Norway

Queensland Coal Board
169 Mouy Street
Brisbane, Queensland 400

Takio Sakaguchi
Vice President
Bulk Systems, Inc.
1130 Panosama Drive
Long Beach, California 90802

Louis B. Schoen
Group Vice President
Philipp Brothers, Inc.
9100 Wilshire Boulevard
Beverly Hills, California 90212

Rollin A. Slater
Director
SORDS-Longworth
McKenzie Pty, Ltd.
Consulting Engineers
3 Eden Street
Crows Nest, NSW

Soros Associates
575 Lexington Avenue
New York, New York 10022

B. David Swenson
Supervisor of Regional Economists
Pacific Ocean Division
U. S. Army Corps of Engineers
Building 230
Ft. Shafter, Hawaii 96859

Graeme Thompson
Chief Economist
New Zealand Planning Council
P. O. Box 5066
Wellington, New Zealand

Ted W. Vorfeld
President
Thermal Engineering Corp.
3049 Ualena St., Suite 210
Honolulu, Hawaii 96019

Jay K. Winter
Vice President
Bulk Systems, Inc.
1130 Panosama Drive
Long Beach, California 90802

Soo-Kil Yoon
Director General
Petroleum Bureau
Ministry of Energy and Resources
Merrok, Seoul
Korea